U.S. DEPARTMENT OF COMMERCE
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PB-289 732

Proceedings of the National Response Team Oil Spill Scientific Response Workshop, New England

MITRE Corp, McLean, VA METREK Div

Prepared for

Environmental Protection Agency, Washington, DC Office of Energy, Minerals and Industry

Oct 78

United States
Environmental Protection
Agency

Office of Energy, Minerals, and
Industry
Washington DC 20460

EPA 600 7 78 196
October 1978

PB 289732

Research and Development

EPA

Proceedings of the National Response Team Oil Spill Scientific Response Workshop, New England

Interagency Energy/Environment R&D Program Report

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SPRINGFIELD, VA. 22161

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TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO.
EPA-600/7-78-196

2.

3. RECIPIENT'S ACCESSION NO.
PB289732

4. TITLE AND SUBTITLE
Proceedings of the National Response Team Oil Spill Scientific Response Workshop, New England

5. REPORT DATE
October 1978

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Edited by: Dr. William G. Conner
Dr. Philip U. Alkon

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Metrek Division of the MITRE Corporation
1820 Dolley Madison Blvd.
McLean, Virginia 22102

10. PROGRAM ELEMENT NO.

11. CONTRACT/~~GRANT NO.~~
68-01-3188

12. SPONSORING AGENCY NAME AND ADDRESS
U.S. Environmental Protection Agency
Office of Energy, Minerals and Industry
Office of Research and Development
Washington, D.C. 20460

13. TYPE OF REPORT AND PERIOD COVERED
Final

14. SPONSORING AGENCY CODE
EPA /600/7

15. SUPPLEMENTARY NOTES
This project is part of the EPA-planned and coordinated Federal Interagency Energy/Environment R&D Program.

16. ABSTRACT

This document presents the final results of a Workshop on oil spill ecological damage assessment held at Hartford, Connecticut, during 28-31 August 1977. The principal aim of the Workshop was to identify scientific needs and capabilities to be incorporated into a regional response plan for assessing the ecological damage due to major oil spills. Results are organized in terms of Workshop plenary sessions, meetings of 10 scientific and technical panels, and meetings of the Workshop executive committee. A draft of this document has been reviewed and revised according to comments from Workshop coordinators and attendees.

17. (Circle One or More) KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Ecology Environments Other: oil pollution, oil spills, petroleum spills, damage assessment	Processes & Effects Transport Processes Ecological Effects Charac. Meas. & Monit. Health Effects Integrated Assessment Fuel Oil-Gas Oil Shale	6F 8A

18. DISTRIBUTION STATEMENT
Release to public

19. SECURITY CLASS (This Report)
unclassified

20. SECURITY CLASS (This page)
unclassified

21. NO. OF PAGES
484

22. PRICE
PC A21 / MF A01

EPA Form 2220-1 (9-73)

☆U.S. GOVERNMENT PRINTING OFFICE: 1978 620-007/3713 1-3

EPA-600/7-78-196
October 1978

OIL SPILL WORKSHOP

Results of the Region I Workshop on Oil Spill Ecological Damage Assessment

Edited by:

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Dr. Philip U. Alkon

July 1978

Contract Sponsor: U.S. Environmental Protection Agency
Contract No.: 68-01-3188
Project No.: 1559P
Dept.: W54

COVER PHOTO: In December, 1976 the *Argo Merchant* ran aground off Nantucket Island spilling 7.5 million gallons of oil. The *Argo Merchant* incident demonstrated the need for coordinated scientific response to major oil spills and was a key factor in precipitating the Oil Spill Workshops. Cover photo courtesy of the U.S. Environmental Protection Agency.

ABSTRACT

This document presents the final results of a Workshop on oil spill ecological damage assessment held at Hartford, Connecticut, during 28-31 August 1977. The principal aim of the Workshop was to identify scientific needs and capabilities to be incorporated into a regional response plan for assessing the ecological damage due to major oil spills. Results are organized in terms of Workshop plenary sessions, meetings of 10 scientific and technical panels, and meetings of the Workshop executive committee. A draft of this document has been reviewed and revised according to comments from Workshop coordinators and attendees.

ACKNOWLEDGEMENTS

The Workshop Coordinator expresses sincere thanks to each participant whose dedicated effort made the Region I Workshop an exceptional success. Because the Hartford meeting was the first in a series of Workshops aimed at developing regional response plans for ecological damage assessment, its achievements are particularly noteworthy. The Workshop brought together outstanding experts in relevant scientific and operational disciplines representing Federal and State agencies, the academic community and private and commercial groups. All participants contributed their expertise and labor voluntarily.

I also wish to thank specifically: Bill Adams, EPA Region I Administrator, for hosting the meeting; the Panel Chairpersons and Executive Committee members, for their contributions above and beyond the call of duty; Carole J. O'Toole, for handling Workshop arrangements; the management and staff of the Hartford Sheraton Hotel, for their helpful cooperation; and Mary Kraus (MITRE Corporation), Robin Lind (EPA Region I) and Sandy Karasuk (EPA, Narragansett, ERL) for expertly handling the difficult secretarial burden of the Workshop.

Paul Lefcourt, Ph.D.
Workshop Coordinator

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INTRODUCTION

Oil spills pose a recognized threat to natural and cultural features in U.S. coastal ecosystems. Up to now, societal resources have largely been directed towards minimizing the exposure of environmental systems to spilled oil and other hazardous materials. The National Oil and Hazardous Substances Pollution Contingency Plan, for example, establishes a quick response interagency capability for identification, containment, dispersal and restoration operations in the event of accidental discharges. Unfortunately, no such capability exists with respect to the evaluation of the ecological consequences of oil spills.

The Region I Workshop on Ecological Damage Assessment represents an initial attempt to meet this need. The Workshop concept arose from recommendations made to the National Response Team-the body charged with oversight of the National Contingency Plan-by a Task Force on Ecological Damage Assessment. The Task Force noted that existing scientific capabilities are not presently organized to provide effective advisory assistance on ecological matters to operational authorities nor to undertake comprehensive and coordinated scientific projects in contingency situations. The Task Force recommended a series of regional workshops as a step in the development of regional and national response plans for ecological damage assessment.

Approximately 135 invited experts participated in the Region I Workshop held at Hartford during the last week of August, 1977. They represented a broad range of scientific and operational expertise from Federal and State agencies, the academic community and the private sector (See Appendix E). The program sought and realized a substantial effort by all participants. It was a workshop in the real sense of the term. The results are evident from this report.

The aim of the Workshop was to identify scientific needs and resources that might be incorporated in a New England regional response plan for ecological damage assessment. Within this context, the Workshop addressed three principal goals:

(1) Provide highly qualified and coordinated scientific support to Regional Response Teams and On-Scene Coordinators during major spill incidents.

(2) Upgrade our capability to assess environmental damage associated with these spills.

(3) Capitalize on the unique research opportunities that are often afforded by major spills and thus improve our ability to support future cleanup and damage assessment activities.

The program consisted of panels dealing with 10 scientific and technical subject areas. Plenary sessions and meetings of the Workshop Executive Committee provided forums for guidance, interaction, and the development of recommendations to the National Response Team. Work is proceeding now on the development of a New England Response Plan that will incorporate results of the Hartford program.

The Hartford Workshop dealt specifically with coastal ecosystems. The achievements at Hartford will be followed by workshops in other U.S. coastal regions. They may also serve as a stimulus for addressing ecological damage response needs in freshwater and terrestrial ecosystems.

PLENARY SESSIONS

Overview

All participants were invited to attend plenary sessions. These meetings were intended to provide overall guidance on Workshop objectives and procedures, to keep participants abreast of Workshop progress, and to facilitate the exchange of ideas among panels and between panels and the Executive Committee. Two plenary sessions were held, one at the start of the Workshop on the morning of August 29, and the second on the morning of August 30. A third session originally scheduled was cancelled to permit participants to devote more time to panel meetings and other Workshop activities.

Summary of Proceedings

The first plenary session (August 29), included the following presentations:

- Introduction to the Workshop

  Paul Lefcourt (EPA)
  Workshop Chairman

A review of the origins of the Workshop program. The impact of the *Argo Merchant* incident on the recognition of the need for more effective application of scientific capabilities for assessing the ecological consequences of coastal oil spills. The report of the Task Force on Ecological Damage Assessment to the National Response Team was reviewed including the recommendation for a Workshop program to develop ecological assessment response plans. Changes in the Workshop schedule were also announced.

- Welcoming Address

  Bill Adams
  Administrator, EPA Region I

Participants were welcomed. A need was indicated for a national plan to deal with ecological aspects of coastal oil spills that would establish mechanisms for Federal, state and local coordination. The important issues are: 1) the present Federal inability to rapidly draw on substantial existing scientific resources; 2) the present limited capability for quantifying ecological damage; and 3) the need for effectively matching scientific specialties to the particular characteristics of individual spills. The need for clear Federal guidance on responsibilities and authorities for damage assessment, and for resources to support the effort, was emphasized.

- Background on Federal Involvement in Oil Spill Programs

Henry Van Cleave
Chief, Spill Prevention and Control Branch
EPA

A review of the history and authorities of Federal oil spill programs. Section 311 of the Federal Water Pollution Control Act (PL 92-500) addressed notification response, removal and other aspects of oil spills. A National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 1510), published by the Council on Environmental Quality, authorized national, regional and subregional operational plans for dealing with oil spills, including the designation of Federal On-Scene Coordinators (OSC). A Federal revolving fund supports cleanup operations, and claims may be made against dischargers. Executive Order 11735 gave primary operational responsibility to the U.S. Coast Guard for spills in coastal waters and on the Great Lakes, and to EPA for inland waters. The EPA is responsible for assessing dispersants, and the Office of Spill Prevention and Control is sponsoring damage documentation studies. The operational contingency plans have been generally effective. Scientific support is needed in: 1) developing acceptable methods for measuring ecological damage; 2) clarifying subtle and long-term ecological effects; and 3) developing improved cleanup methods and criteria for terminating cleanup operations. The Workshop effort should eventually lead to augmentation of the National Contingency Plan.

- Background on the National Response Team (NRT)

Capt. John Kirkland
Chief, Environmental Protection Division
U.S.C.G.

Review of NRT organization and functions. The NRT is an interagency standing committee for monitoring oil spill response capabilities. Primary agencies represented are the Departments of Commerce, Defense, Interior, Transportation, and EPA. Advisory agencies are the Energy Research and Development Administration and the Departments of State; Justice; Health, Education, and Welfare; and Housing and Urban Development. The National Contingency Plan deals with ecological damage assessment under 40 CFR 1510.32 - (a), (b), and (c). State involvement and representation, an important aspect of the Plan, are addressed in 1510.34 (c). The present Workshop Executive Committee is an *ad hoc* body of the NRT. Research activities should not interfere with cleanup operations, which are the principal responsibility of the OSC. The OSC does require expert scientific advice to support operational decisions.

- Description of the NOAA/USCG Spilled Oil Research Team (SORT)

David Kennedy
NOAA Environmental Research Laboratory
Boulder, Colorado

The NOAA/USCG SORT is headquartered at Boulder. It deals primarily with physical aspects of spills and is presently refining oil spill trajectory models utilizing field data. The SORT is structured around a group of volunteer teams with facilities located at various points around the country. Spills of opportunity are investigated by the nearest available team utilizing nationally available resources as needed. The concept has been tested at natural oil seeps near Santa Barbara, and SORT served as a primary coordinator for scientific activities carried out in connection with the *Argo Merchant* incident. SORT is part of the NOAA Outer Continental Shelf Environmental Assessment Program funded by the Bureau of Land Management, Department of Interior.

- Socioeconomic and Legal Considerations

Jan Praeger
EPA Environmental Research Laboratory
Narragansett, Rhode Island

The relevance of economic and legal aspects to ecological damage assessment was summarized. In the context of damage assessment, scientific efforts should be aimed at estimating costs in economic terms and in developing information that can be used as testimony in legal proceedings. The Socioeconomic and Legal Panel will attempt to develop guidelines for scientists on the legal requirements for ecological information. The scientific and technical panels must consider the legal and economic framework in developing recommended scientific programs.

- Plan for the Workshop

Paul Lefcourt
Workshop Chairman

Review of Workshop schedule (Appendix A), performance guidelines and goals. Role and membership of the Executive Committee were discussed and Panel Chairpersons were introduced. Mention was also made of pending legislation that would include a $200M "superfund." One application of this fund may be for damage assessment.

The Plenary Session of 30 August involved a progress review by Panel Chairpersons and notification of changes in the Workshop schedule.

PANEL MEETINGS

Overview

The major scientific effort of the Workshop was carried out in panels organized according to the following subject areas:

- Benthic Biology
- Microbiology and Biodegradation
- Birds and Marine Mammals
- Chemical Analysis and Fate
- Physical Processes
- Water Column Biology
- Histopathology
- Laboratory Toxicity
- Socioeconomic and Legal Aspects
- Facilities and Data Management

The overall charge of the panels was to produce recommendations to the Executive Committee on scientific and technical requirements and resources for application in an oil spill response plan for ecological damage assessment. To the greatest possible extent, each recommended project was described according to a 14-point format that addressed cost, facility and personnel requirements, and feasibility, as well as scientific aspects (see Appendix B).

Panel meetings were chaired by authorities in the respective subject areas (see Appendix C). Panel Chairpersons attended an orientation meeting held at Narragansett during August. At the Workshop, Chairpersons provided panel members with written guidance on objectives and procedures, attended two joint meetings with the Workshop Executive Committee, and met jointly with the Workshop Chairperson. The latter session, held on August 30, addressed several topics including: interactive needs among the various scientific disciplines; lead agency responsibilities for ecological damage assessment; procedures for review of the Workshop report; plans for the development of the regional response plan; and the formation of a national scientific review panel for oversight of ecological damage assessment programs.

Results of the individual panels are presented in following sections.

BENTHIC BIOLOGY PANEL

Participants

D.A. Wolfe, Chairperson

A. Carr
F.R. Cantelmo
W.R. Davis
R. Estabrook
C. Fredette
C. Gifford
G.R. Hampson
E.B. Hatfield

J. Hyland
G. LaRoche
R. McGrath
J. Morris
P.M. Nolan
S.D. Pratt
A.N. Sastry
J.M. Teal

BENTHIC BIOLOGY PANEL

General Information and Guidance

- Objectives of Panel
- Issues and Approaches Pertinent to Damage Assessment
- Research Considerations

OBJECTIVES OF PANEL

- To identify and define those studies or projects (in accordance with the 14-point "Panel Guidance Format") relevant and useful for ecological damage assessment in reference to benthos.
  - Area of interest extends from high tide line out to shelf break (or reasonable operational depth limit).
  - Damage assessment should consider not only effects of spilled oil *per se*, but also effects of cleanup or mitigation procedures employed.
  - Need to identify expected interfaces with other panels in terms of information and sample needs.
- To specify fundamental research projects which can be conducted under unique spill conditions to improve future damage assessment or spill response capability.
- To identify regional expertise on benthic biomes for potential USCG support.

ISSUES AND APPROACHES PERTINENT TO DAMAGE ASSESSMENT

A. Pre-spill Ecological Characterizations

1. Select sites based on:
   - representativeness of habitats
   - probable vulnerability to spills (analysis of probable sources and trajectories)
   - economic values

2. Focus on key species (commercial/indicator, life stage)

  - standing crop
  - biological productivity
  - catch statistics
  - reproductive cycles
  - feeding relationships/dependencies
  - behavioral parameters
  - disease types and incidence, tumors

There is a need to select key species at the start, based on currently available information, and then to pursue the base line measurements. Ecosystems cannot be studied to determine key species.

3. Determine infaunal community structure

  - relative abundances
  - diversity
  - trophics
  - succession

4. Abiotic factors

  - sediment types/composition
  - current regimes
  - nutrient cycles/flux

5. Death assemblages

  - mollusc shells (population and size frequency)
  - polychaete jaws
  - amphipod eyes

6. Shoreline characteristics

  - salt-marsh distribution, species composition
  - Zostera, algal beds
  - erosion/deposition rates

  (potential applicability of satellite imagery)

B. When Spill Occurs

1. Survey Measurements

  a. Need to base final details of study designs on specific characteristics of spill in real time:

- availability of relevant base line measurements
- extent of spill
- timing of spill
- oil type
- how much oil reaches bottom

The Panel emphasized the need for flexibility at prerogative of on-the-scene scientists.

b. Study Parameters

Based on specific characteristics of spill, lead time, availability of relevant base line, measure any or all of parameters outlined in A1 through A6, compared to:

- long-term base line in impact area, if available from literature or recent studies
- instantaneous pre-spill base line in impact area (one or more samples collected immediately before spill impacts the study site)
- simultaneous measurement in adjacent "control" areas

2. Diagnostic Experiments

a. *In-situ* cage experiments for selected key species

- mortality
- growth/respiration
- behavior

b. Microcosm experiments

- invasion/recruitment/succession in sediment trays
- invasion/recruitment/succession in fouling plates

c. Bioassays

- bell jar experiments at unimpacted sites using spill oil
- lab experiments using spill oil or impacted sediments/key species
- mutagenesis in microorganisms/cell cultures

d. Mollusc shell microstructure and chemical composition

3. Interfaces

   - chemical analyses (especially polynuclear aromatics)
   - histopathology
   - microbiology

RESEARCH CONSIDERATIONS

A. Research Problems

1. Determine effects of cleanup/mitigation alternatives (burning, bulldozing, steam cleaning, dispersants)

2. Determine effects of nutrient additions on biodegradation rates (see Microbiology and Biodegradation Panel Section)

3. Define food chain transport of petroleum

   - study specific known trophic links
   - compare fluxes for different compounds/classes

4. Define role of animals in transport of oil into sediments

In summing up the research needs, the Panel strongly emphasized the continuing need for long-term ecological studies to determine recovery rates and potentials.

B. Habitat Considerations

The Panel decided to structure the ecological damage assessment research around four distinct benthic habitat types which would require different bases of logistic support or different sampling approaches. These were:

- Rocky Intertidal

- Sand-mud Intertidal (including salt marshes)

- Shallow Subtidal

- Offshore

In many cases, the scientists most qualified to address ecological problems differ from one habitat to the next, and the distinction by habitat would also be useful from a contracting point of view. It should be understood, however, that for a given spill any one or all of the habitats may require study, depending upon the size and location of the accident.

The Panel further decided that the survey approach (see Sections IIA1-IIA6, and IIB1, above) held the greatest promise for damage assessment. The diagnostic approaches (see IIB2) might provide insight on survey design, but none of the diagnostic tools has been developed to a stage of providing a quantitative measure of damage without backup survey information. The contractor selected for the survey work might use any or all of the diagnostic approaches in his final damage assessment.

BENTHIC BIOLOGY PANEL

Recommended Projects

1. Oil spill damage assessment of onshore rocky intertidal environments.

2. Oil spill damage assessment of onshore intertidal environments: sand and soft bottom types.

3. Oil spill damage assessment for the benthic community in shallow subtidal environments.

4. Initial assessment of damage to benthic environment following a medium to large offshore spill.

*5. Effects of petroleum hydrocarbons and/or dispersants on estuarine communities under flow-through laboratory conditions.

*6. Effects of oil pollution on species interactions: caging experiments.

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*Projects 5 and 6 were identified in the panel report as Appendices I and II, respectively. Both are considered to be diagnostic approaches for use at the discretion of the benthic survey contractor.

PANEL: BENTHIC BIOLOGY
PROJECT NO: 1
PRIORITY RANK:

1. Project Title: Oil Spill Damage Assessment of Onshore Rocky Intertidal Environments

2. Project Description:

   A. Objectives:

      (1) Using grid and transect analyses, determine the short-term effect of the oil on the benthic community by comparing the spill area to an unimpacted area and/or baseline data. Triplicate samples recommended.

      Determine: (a) Biomass

      (b) Relative species abundance

      (c) Diversity

      (2) Determine long-term effects by looking at repopulation of the impacted area.

      Look at: (a) Species succession

      (b) Settlement and development of larval forms

      (3) Detailed visual observations are recorded.

   B. A good reference list on the effects of oil on the rocky shore benthos (both plant and animal) should be compiled and made available.

   C. See Projects 5 and 6 for possible diagnostic experiments.

      (1) See Dale Straughan *et al*. for many references on Santa Barbara spill.

3. Performing Organization:

   A. Limited state and Federal capability

   B. Definite capability

(1) Normandeau Associates, Inc.

(2) Woods Hole Oceanographic Institute - Marine Biological Laboratory

(3) URI - Graduate School of Oceanography

(4) EG&G - Dr. Charles Menzie

(5) Northeast Marine Environmental Institution

C. Possible capability

(1) Dr. Mathieson - Dept. of Botany, University of New Hampshire - macrophyte community

4. Applicable Habitats:

Rocky shoreline - most of shore from northern Maine coast, south to New Hampshire and northern Massachusetts, isolated area from Cape southward including:

A. Exposed rocks

B. Rocky intertidal pools

C. (mussel reefs?)

5. Applicable Conditions:

A. Sufficient oil should reach the rocky shoreline to produce the expected significant petroleum hydrocarbon damage to a viable benthic community.

B. Good base line data is desirable.

C. Uncontaminated control site is desirable.

D. Season/weather must be considered to evaluate effects of winter icing, storm damage, etc., in addition to oil effects.

E. Site should be accessible by land vehicle (or boat for offshore islands reef).

F. Relative position of impacted area to other pollution sources such as power plant discharge, habor, sewage effluent, etc. should be considered.

G. Presence of commercially harvestable crop (mussels, seaweeds) will affect study.

H. Adequate funding for project completion must be committed to specific research organization prior to project implementation.

6. Applicable Oil Type:

All types.

7. Time Frame:

Intensive study initially with the continued duration and frequency of sampling dependent upon season, weathering of oil, and responses of community structure.

Within 1 year a presentation of the acute impact of the spill will be available.

8. Costs:

Dependent on duration and frequency of sampling and location of spill. Possible scenario:

Field Days - Daily for 2 weeks = 10 days
Weekly for 3 months = 12 days
Seasonally for 1 yr = 3 days
25 days

5-man team = 5 x 25 = 125 man-days in field
Lab days - 5 lab day/field days = 5 x 125 = 650 man-days in lab
Total man-days = 125 + 650 = 750
Cost - \$125/day/scientist = \$125 x 750 = \$95,000

9. Equipment Needs/Equipment Available:

A. One per field sampling team
  (1) Portable 1 ft^2 grid
  (2) Scraper (putty knife)
  (3) Wash bucket
  (4) Brush
  (5) Sieve
  (6) Dip net
  (7) Spade

(8) Waders (1 per person)
(9) Camera

B. Other field equipment

(1) Bags, jars, formalin - number depends on number of samples taken

(2) Field and lab data cards - number depends on number of samples taken
(3) Glass bottles for hydrocarbon analysis - number depends on number of samples taken
(4) Meter stick
(5) Visible, durable markers to mark sampling site - stakes, fluorescent paint, etc.

C. Lab equipment

(1) Wash bottles, tweezers
(2) Microscope
(3) Dissecting equipment
(4) Keys for identification of organisms.

Organizations listed in item (3) generally have above equipment available.

10. Facility Needs/Facilities Available:

A. Open boat (16'-20') - trailerable

B. 4-wheel drive land vehicle

C. Helicopter for shoals and islands

D. Living accommodations at sampling site

E. Lab space

11. Personnel Needs/Personnel Available: A list consisting of 3 to 8 people should be compiled of experts in New England.

A. Marine botanist

B. Marine invertebrate taxonomist

C. Invertebrate early larval development specialist

D. Knowledge of physical oceanography in the area

12. Support Services:

A. Hydrocarbon analysis

- tissue analysis
- ambient water concentration analysis
- follow weathering processes

B. Resource analysis - how important is area?

(1) Commercial fishery
(2) Harvestable seaweed
(3) Recreation
(4) Considered for future development
(5) Unique species present

C. Histological analysis

D. Spore settlement of algae

E. Chemical (lipid) analysis of tissue

13. Payoff:

A. Initial mortality and long-term loss in productivity of economic and/or food species will be determined.

B. Scientific interest - there is scant documentation of effects of oil spill on the rocky coast.

C. There are harvestable economic resources within the rocky shore; e.g., Irish moss, mussels, etc.

D. Information will help to manage fisheries forecast and cleanup operation.

14. Limitations:

A. Manpower - get most out of limited funds and manpower available

B. Weather

C. Season

D. Taxonomic expert availability

PANEL: BENTHIC BIOLOGY
PROJECT NO: 2
PRIORITY RANK:

1. Title: Oil Spill Damage Assessment of Onshore Intertidal Environments: Sand and Soft Bottom Types

2. Project Description:

The impact of an oil spill on the structure and function of benthic communities will be accomplished by a two-phase program composed of a survey effort coupled in the second year to a research program. The first phase will be a short and long-term quantitative and qualitative sampling program to determine the immediate mortality and long-term disruptions of the intertidal system. Special focus will be on the populations and physiological changes of key species which will include economically important organisms. The macrofauna, meiofauna and microfauna will be considered. This survey will result in determining the spacial and temporal extent of oil exposure effects and will serve as a basis for assessment of environmental damage and economic loss.

The second phase, to begin the end of the first year and then run concurrently with the limited survey, will utilize both research and experimental techniques. Such research and diagnostic experiments as suggested and outlined in the Appendices (Projects 5 and 6) will deal with productivity, respiration, death assemblage, changes of sediment profiles due to the impact of oil, cage experiments, etc. These would be employed as a useful tool if appropriate in a given habitat to provide further definitive data relating to damage assessment.

References:
- a. Sanders et al (West Falmouth oil spill; in manuscript)
- b. Krebs and Burn 1977
- c. Michaels et al 1975

3. Performing Organization:

Marine Biological Laboratory - Woods Hole

Jackson Estuarine Laboratory - University of New Hampshire

University of Rhode Island

Northeast Marine Environmental Institution

EG&G - Dr. Charles Menzie

Bigelow Lab - Booth Bay, Maine

EPA Lab, Lexington

EPA Lab, Narragansett

Ira Darling Lab, University of Maine

Marine Research Inc., Falmouth, Massachusetts

Massachusetts State Marine Fisheries, Sandwich, Massachusetts

4. Applicable Habitats:

Onshore intertidal systems: sandy beaches, mud bottom and salt marshes.

5. Applicable Conditions:

This study can be carried out under the most extreme conditions. Sampling techniques and work schedules may be modified to fit the given conditions and circumstances. This project should be put into action whenever a viable benthic community is significantly damaged by oil. Adequate funds for project completion must be committed to the research organization prior to the implementation of the project.

6. Applicable Oil Type:

All types.

7. Time Frame:

The survey phase requires an immediate intense study period of about a month, followed by a period of intermediate intensity up to one year duration, and then a study period of low intensity, i.e., seasonal or annual sampling, for as long as the spilled oil is present in the sediments. The second phase, i.e., research and experimental, should commence during the first year and run concurrently for the duration of the project.

A series of times should be established for preliminary reports with a comprehensive presentation of the data at the end of each sampling year.

8. Costs:

A. Sandy intertidal

(1) 1-mile stretch

(a) Survey work

Year 1	$ 50,000
Year 2	30,000
Years 3-6	10,000/yr

(b) Research work

Years 2-6	40,000/yr

(2) 5-mile stretch

(a) Survey work

Year 1	$ 96,000
Year 2	50,000
Years 3-6	20,000

(b) Research work

Years 2-6	60,000/yr

(3) 20-mile stretch

(a) Survey

Year 1	$180,000
Year 2	75,000
Years 3-6	37,500/yr

(b) Research

Years 2-6	90,000/yr

B. Muddy intertidal

(1) 1-mile stretch

(a) Survey

Year 1	$ 80,000
Year 2	50,000
Years 3-6	20,000/yr

(b) Research work	
Years 2-6	$ 50,000/yr
(2) 5-mile stretch	
(a) Survey	
Year 1	$160,000
Year 2	100,000
Years 3-6	40,000/yr
(b) Research	
Years 2-6	70,000/yr
(3) 20-mile stretch	
(a) Survey	
Year 1	$300,000
Year 2	150,000
Years 3-6	75,000/yr
(b) Research work	
Years 2-6	100,000/yr
C. Salt marsh	
(1) 1 hectare	
(a) Survey - excluded meiofauna	
Year 1	$ 60,000
Year 2	40,000
Years 3-6	20,000/yr
(b) Research work	
Years 2-5	100,000/yr
(c) Survey to include good meiofauna work	
Year 1	120,000
Year 2	100,000
Year 3	80,000
Years 4-6	50,000/yr

(d) Research work

Years 2-5 $150,000/yr

9. Equipment Needs/Equipment Available:

Field equipment - cameras, quadrats, corers, dredges, sieves, sample containers, etc., and items commonly used for such studies and readily available in all the above listed laboratories.

Lab equipment - microscopes, identification keys, glassware, sorting trays, etc.

Special items of equipment for the experimental and research phase may include respirometers, spectrophotometers, oxygen probes, light meters, thermometers, etc.

10. Facility Needs/Facilities Available:

Land vehicles, small boat (under 20 feet with trailer), laboratory space and storage space.

11. Personnel Needs/Personnel Available:

Personnel should be knowledgeable of New England intertidal systems and familiar with working and sampling the benthic community. Estimated personnel required would range from 5 to 12 individuals depending on size of oil spill. Individuals must also be willing and able to accept the work on short notice.

Some suggested individuals who might be available and willing:

Howard Sanders George Hampson Fred Grassle John Teal	Woods Hole Oceanographic
George Woodwell John Hobbie Bruce Peterson Cameron Gifford	Marine Biological Lab - Woods Hole
Ivan Valier	MBL - BUMP
George Matthuessen	Falmouth Marine Res. Inst.
Robert Croker	Jackson Estuarine Lab, UNH
Ned Hatfield)	Jackson Estuarine Lab, UNH
Les Watling	Ira Darling Lab

A.N. Sastry	University of Rhode Island
Scott Nixon	
Candace Oviatt	
Nelson Marshall	
H.P. Jeffries	
Sheldon Pratt	
Lee Doggett	Bigelow Lab
Peter Larsen	Bigelow Lab
Joe Graham	State of Mass., Dept. of Marine Res.
Paul Godfrey	Univ. of Mass.
Frank Cantelmo	City College, NY
Allan Michaels	Taxon Inc., Salem, Mass.

12. Support Services:

A. Hydrocarbon analysis

(1) Rapid technique survey, i.e., ultraviolet fluorescence to determine extent of oil in sediments.

(2) Detailed analysis (complete fingerprinting) of spilled oil with a time sequence of weathering of the oil, a vertical and temporal distribution in the sediments and a detailed analysis of hydrocarbons in selected key species.

B. Sediment particle size frequency analysis

C. Chemical analysis

(1) Analysis of the vertical distribution of chemicals in sediments, i.e., organic carbon, nitrogen, phosphorous, etc.

(2) Lipid analysis of selected organism tissues.

D. Histopathological analysis of selected organisms which play a significant role in the structure and function of the community and form the basis of community productivity both biological and economic.

13. Payoff:

This project would determine initial mortality and long-term loss in productivity of economically important species and/or food species in various trophic levels, and should also contribute to our understanding and ability to predict the impact of oil on the structure and function of the intertidal benthic communities. Information generated by this work would also help to manage fin fisheries or shell fisheries which have been impacted and help direct cleanup as well as manage recovery of the site.

14. Limitations:

Availability of competent individuals who are willing to do the work on short notice or do the work at all. For example, there is one person in the Northeast competent to identify soil arthropods from salt marshes. He may not have time or be willing to work on this type of project at the time a spill occurs.

PANEL: BENTHIC BIOLOGY
PROJECT NO: 3
PRIORITY RANK:

1. Title: Oil Spill Damage Assessment for the Benthic Community in Shallow Subtidal Environments

2. Project Description:

The benthos is a prime area of concern when considering the potential impact of petroleum hydrocarbons on aquatic communities. This is based upon 1) documented proof that marine and estuarine bottom sediments provide natural sinks for the accumulation of toxic petroleum hydrocarbons; 2) the potential vulnerability of many benthic communities to oil impact as a result of the broad taxonomic representation of constituent species and in many cases their seemingly apparent longevity, immobility, sensitivity, and ability to concentrate toxic substances; and 3) realization of the significant functional roles that benthic communities play, including recirculation of vital nutrients to pelagic phases and the production of both primary and secondary sources of food that are commercially important to man.

Consequently, it is imperative that we study the effect of oil spills on benthic communities in order to assess the overall impact on the health of coastal marine ecosystems.

In response to a spill, samples will be collected at designated control and impacted sites employing appropriate quantitative sampling methodology and will be processed by standard analytical and data reduction techniques which are generally available. Temporal and spatial changes in species abundance and distribution will provide the data base necessary to properly assess the impact of the spill on benthic community structure.

3. Performing Organization:

Recognized local groups with demonstrated capability in the design and execution of benthic programs include the following:

Bigelow Laboratory, West Boothbay, ME

Normandeau Associates, Manchester, NH

University of New Hampshire, Durham, NH

Taxon, Inc., Salem, MA

Northeast Marine Environmental Institution

Woods Hole Oceanographic Institute, Woods Hole, MA

Marine Biological Lab., Woods Hole, MA

University of Rhode Island, RI

Marine Research Incorporated, Falmouth, MA

National Marine Fisheries Service, Woods Hole, MA

Yale University, New Haven, CT

CUNY, New York, NY

Lamont-Doherty, Palisades, NY

Texas Instruments, Inc., Buchanan, NY

New England Aquarium, Boston, MA

EG&G - Dr. Charles Menzie

4. Applicable Habitats:

   A. Offshore bottom

   B. Worm-clam flat

5. Applicable Conditions

   Conditions which must be satisfied in order to successfully complete this project include the following:

   A. Base line data or appropriate control sites must be available.

   B. Oil is incorporated into the sediments.

   C. Weather conditions permit sampling - in this case the weather conditions which would preclude sampling are intermediate between those for onshore studies and those for offshore studies.

   D. The presence of a viable benthic community in the potential impact area(s).

E. Funding adequate to ensure successful completion of the project must be committed prior to its inception.

6. Applicable Oil Type:

All oils and related petrochemicals.

7. Time Frame:

This project requires frequent sampling from day 0 through approximately day 30, although the actual extent of this intensive sampling period will vary for each spill and should be left to the discretion of the study team and OSC. From approximately day 30 to 1 year, the intensity of sampling may be gradually reduced, again at the discretion of the study team. Long-term monitoring on a seasonal basis should be conducted until such time as the oil is no longer present in the sediments or the benthic communities regain a "normal" stability. There is no time frame which may be applied universally.

8. Cost:

A wide variety of site-specific variables preclude an accurate *a priori* assessment of costs for a benthic program. Sample processing times are dependent upon the nature of the sediment can easily vary by over two orders of magnitude. The costs quoted here must be considered as "ballpark" estimates and should be used with caution.

A typical benthic program designed to develop the information needed to assess damage for a moderate spill in a semi-enclosed bay of shallow depth would include approximately 20 to 25 stations. At least three, and preferably five, replicate samples should be taken at each station at each sampling event. Assuming no unusual conditions, such a study, for a period of six years, would cost approximately $600,000 complete with 30% of the costs being incurred in the first year. This estimate is based on an estimated sample volume, after sieving, of two quarts which may be considered typical for inshore samples.

9. Equipment Needs/Equipment Available:

Field equipment for this project includes:

A. Sampling device (Smith-McIntyre, or equivalent) and supporting stand

B. Assorted buckets, jars, etc.

C. Sieves of appropriate mesh size

D. Formalin

E. Various and sundry minor items which are widely obtainable

10. Facility Needs/Facilities Available:

Facilities required for benthic work are not extensive but include the following:

A. Appropriate vessel - 65' boat appropriate if there is enough depth, otherwise a smaller craft may be adapted.

B. Laboratory with large amount of counter space and storage space which may also be used for staging.

C. Adequate microscopes.

D. Assorted dishes, jars and reference materials.

11. Personnel Needs/Personnel Available:

Proper personnel are critical to the successful completion of this project. Taxonomic specialists are always in demand because there are so few of them. Personnel with proven expertise in benthic studies include the following:

Howard Sanders	Woods Hole Oceanographic Institute
George Hampson	
Fred Grassle	
John Teal	
George Woodwell	Marine Biological Lab - Woods Hole
John Hobbie	
Bruce Peterson	
Cameron Gifford	
Ivan Valier	MBL - BUMP
George Matthiessen	Falmouth Marine Res. Insti.
Robert Croker	Jackson Estuarine Lab, UNH
Ned Hatfield	Jackson Estuarine Lab, UNH
Les Watling	Ira Darling Lab
Lee Doggett	Bigelow Lab
Peter Larsen	Bigelow Lab
Joe Graham	State of Maine, Department of Marine Resources

A.N. Sastry Scott Nixon Candace Oviatt Sheldon Pratt	URI - Graduate School of Oceanography
Paul Godfrey	University of Massachusetts
Frank Cantelmo	City College, NY
Allan Michaels	Taxon Inc., Salem, MA

12. Support Services:

Additional data inputs which may be of critical value in the interpretation of the faunal data include:

A. Hydrocarbon content of sediment.

B. Sediment grain size.

C. Histopathological analysis of selected species.

13. Payoff:

Important knowledge gained through this type of study includes:

A. Assessment of the ecological damage and economic loss due to impact of spilled oil on a major ecosystem component.

B. Long-term data at control or unimpacted sites will provide presently unavailable information about long-term benthic community variability.

C. The program will provide specimens for potential use by other groups.

D. Accurate information on the status of commercial benthic species will be made available to local agencies.

E. Immediate guidance will be provided to assist in the direction of cleanup efforts.

14. Limitations:

A. Sufficient taxonomic expertise may be unavailable and considerable delay may result.

B. Costs for developing a good statistical study are often prohibitive and the compromise study which results is of limited value.

C. Even with sufficient personnel and funds there is always a lag between collection of samples and availability of data. This is typically longer for benthos than for most other areas.

PANEL: BENTHIC BIOLOGY
PROJECT NO: 4
PRIORITY RANK:

1. Title: Initial Assessment of Damage to Benthic Environment Following a Medium to Large Offshore Spill

2. Project Description:

To determine the impact of an oil spill on the structure and function of offshore benthic communities, the project will emphasize the initial impact, and is designed to accomplish the following objectives:

A. Identify dead or moribund organisms.

B. Take samples for quantitative community analysis.

C. Map the extent of the impacted area and provide a basis for recognizing spill-caused impact by sampling stations at control sites and spill sites for community characteristics and for death assemblages.

3. Performing Organization:

A. URI

B. Coast Guard

C. Commercial fishing boats

D. NUS (Naval Underwater Sys. Lab)

E. WHOI - Densmore

F. NMFS - Dr. George Kelly

G. EG&G - Dr. Charles Menzie

If ships are to be provided, benthic biologists at several other institutions may be interested in conducting these studies. See the institutional list for shallow-subtidal environments.

4. Applicable Habitats:

Offshore bottom

5. Applicable Conditions:

A. Hard funding must be available to the performing organization prior to inception of the study.

B. Experienced coordinated team must be available and committed to project.

C. Physical, chemical and biological inventory of site under investigation is rapidly accessible (quantitative baseline is desirable).

6. Applicable Oil Type:

All types

7. Time Frame:

Minimum of two trips to define problem and the extent of area affected.

A. Detection of initial mortality, changes in death assemblage, and oil presence should be done during first 3-4 days.

B. Survey to determine the limits of area affected and estimate initial impact will require 1-2 weeks.

If severe impact is indicated by the preliminary cruises, additional sampling may be required to determine the duration of the effects.

8. Cost:

Note 1 - Consult with WHOI for "Oceanus" costs and URI for "Endeavor". The costs for cruises responding to the Argo Merchant spill are a good example.

Note 2 - Costs do not reflect sample workup or data handling (drafting and computer costs).

3-4 day initial cruise

Ship @ 2-5k/day	=	$ 6,000	-	$ 20,000
Personnel	=	12,500	-	15,000
Standby, etc.	=	20,000	-	40,000

Second cruise

Ship - 10-14 days	=	$20,000	-	70,000
Personnel	=	26,000	-	40,000
Standby, etc.	=	50,000	-	120,000

9. Equipment Needs/Equipment Available:

A. Quantitative grabs (4) - 1/25 m^2 area - 2 Smith-McIntyre

1/25 m^2 area - 2 Van Veen

Openable top for access

Tight seal for covers

B. Box core - quantitative grab

C. Dredges

(1) Epibenthic sled
(2) Modified scallop dredge (with smaller mesh insert removable)
(3) Small rocking chair dredge

D. Gravity corer

Storage depot advisable to store equipment. Mandatory to have person in charge to keep equipment in working order and keep track of same.

E. Sampling and storage containers of various sizes should be available at same location.

F. Formalin and ethyl alcohol, 55 gal drums, plastic bags, containers for approximately 200 samples - 1/2 pts, pts, quarts, gallon jugs, 3 gal jugs.

The research organizations mentioned in Item 3 will have most of these equipment needs on hand.

10. Facility Needs/Facilities Available:

Only involved with medium to large spills.

Ships - A. Should have adequate winches (hydro and main trawl)

B. At least minimum speed of 1 knot capability

C. Requirements and facilities for a minimum of 3 continuous days of operation:

   (1) Minimum size 65 feet; preferred size 100 feet plus (North Atlantic)

   (2) Adequate storage facilities for gear and specimens alive, i.e., refrigeration, operation pumps.

D. Loran C or satellite navigation. Fathometer, meter wheel.

11. Personnel Needs/Personnel Available:

Availability of personnel dependent on previous commitments and with adequate contingency fund available. Support of two teams would assure availability of a crew within a 3-day preparation time. Suggested sources of staff - Southern New England: WHOI, NMFS (WH), URI, MBL, etc. Northern New England: Taxon, Inc.; Bigelow Lab; University of Maine; UNH; North Eastern University, etc. (personnel - see inshore benthic personnel list).

12. Support Services:

A. Hydrocarbon analysis (UV-fluorescent-HCs from our benthic grabs) dissolved and particulate matter, if possible stomach analysis of various marine animals.

B. Mechanical sediment analysis.

C. Histological examination of selected organisms. See Histochemistry Panel Report. Resources will be emphasized in the offshore area and physiology will be de-emphasized.

13. Payoff:

Information generated by this project would:

A. Define impacted area.

B. Define initial impact severity.

C. Determine communities and species involved.

D. Determine impact on commercial species and habitat thereof: i.e., destruction of food sources and identification of possible routes of petroleum transfer.

E. Describe physical habitat destruction and describe changes to natural habitat of selected invertebrates.

14. Limitations:

Weather - icing.

Ship availability.

Availability sampling gear and ship board gear.

Personnel.

This survey defines the impacted area and the impacted species. Complete processing of all samples has not been planned or costed. The design of such work would depend on the results of the survey. Rocky bottom benthos is almost impossible to quantify.

PANEL: BENTHIC BIOLOGY
PROJECT NO: 5
PRIORITY RANK:

1. Title: Effects of Petroleum Hydrocarbons and/or Dispersants on Estuarine Communities under Flow-Through Laboratory Conditions

2. Project Description:

The objective of this project would be to determine the effect of hydrocarbons and/or dispersants on developing macrofauna and meiofauna populations from local estuarine areas. Seawater pumped in from the estuary would be supplied to the control and experimental aquaria. The experimental aquaria would be supplied with metered amounts of the petroleum and hydrocarbons and/or dispersants from a local spill. Each appartus described by Hauser (1974) contains 10 adjacent aquaria 56 cm long, 9 cm long wide and 12 cm high. Aquaria are filled to a depth of 6 cm with autoclaved sand available from the local estuary and water levels are maintained at 3 cm above the surface of the sediment. After a prescribed time period (6-10 weeks), aquaria are harvested for macrofauna and meiofauna. Analysis of the benthic components in these aquaria will yield results regarding the impact of petroleum hydrocarbons on developing estuarine communities. System described by Hauser (1974) is presently being used at EPA - Gulf Breeze, Pensacola, Florida, by S. Tagatz and his associates. The system appears useful for maintaining both macrofauna and meiofauna for 6-10 weeks to evaluate the effects of various pollutants on coastal benthic ecosystems (Cantelmo and Rao 1977a, 1977b; Tagatz *et al* 1977). An alternate design would be to introduce contaminated sediments with their associated macrofauna and meiofauna into experimental aquaria. Control sediments (not impacted with hydrocarbons from the spill) could also be introduced into the control aquaria. Results of the alternate design would yield results on effects of hydrocarbons on established benthic communities.

3. Performing Organization:

Any organization having flow-through facilities and sufficient laboratory space 20-30' of lab bench space. Persons and/or organizations capable of doing such work include:

The Jackson Estuarine Laboratory (Edward Hatfield)

The New England Aquarium, Palisades, NY (F. Cantelmo).

The Graduate School of Oceanography - URI.

EG&G - Dr. Charles Menzie

Northeast Marine Environmental Institution

4. Applicable Habitats:

System is best used in sand or sand/mud.

5. Applicable Conditions:

Need sufficient pumping facilities to maintain a flow rate of 200 ml/min to each aquarium. Intake pumping facilities should be located approximately one meter off the bottom. Pumping facilities cannot operate under conditions of severe icing. It would be advantageous to locate the intake in at least 5-10 meters of water.

6. Applicable Oil Type:

Cannot use oil that cannot be readily pumped into the aquaria. This may apply to some crudes and some No. 6 oils.

7. Time Frame:

The entire experiment would require 6-10 weeks and an additional 2-3 months to work up samples and analyze findings.

8. and 9. Cost and Equipment Needs:

Depending on availability, laboratory space would cost a maximum of $6,000/year.

	Total Cost
4 - Metering pumps (2,500 each)	$ 10,000
1 - Compound Microscope	5,000
2 - Dissecting microscope	4,000
Sieves, cores, glass, tubing	1,000
Estimate total cost for equipment to be:	25,000
1 - Full-time technician	10,000

2 - Part-time professionals (30 working days for each experiment - this includes setting up system, identifying organisms, analyzing data)

	Total Cost
4 - Part-time technicians (sorters of benthic samples, hired for two months)	6,200
Total cost of personnel and equipment per spill	$50,000 - $60,000

10. Facility Needs/Facilities Available:

Laboratory supplied with flowing seawater system and ample laboratory bench space (20-30').

11. Personnel Needs/Personnel Available:

List of possible workers in benthic ecology available from other infaunal projects.

12. Support Services:

Need adequate amounts of petroleum hydrocarbons to be taken at spill area and transported back to laboratory. For the alternate design sediment has to be secured from grab samples. This necessitates taking 1 or 2 extra grabs/station.

13. Payoff:

The greatest payoff would be to get a relatively rapid estimation of the effect of hydrocarbons from the spill area on developing and established benthic communities. Studies conducted under controlled laboratory conditions may make it easier to assess or determine the economic costs of damage to commercially important species. In addition, flow-through bioassays of the type described will enable greater cooperation by chemists, biologists and geologists in assessing oil spills. The same system used by the biologist can be monitored by the chemist for hydrocarbon levels, metals, etc., and also analyzed by the geologist for sedimentary parameters.

14. Limitations:

Limitations include icing conditions that would interfere with the seawater pumping facilities as well as the inability to exactly simulate the weathering conditions of oil in the natural environment.

PANEL: BENTHIC BIOLOGY
PROJECT NO: 6
PRIORITY RANK:

1. Title: Effects of Oil Pollution on Species Interactions: Caging Experiments

2. Project Description:

The objectives of these experiments are to analyze the cause and effect relationship between spilled oil and the fauna or flora present. The results would allow separation of the effects of oil from those of other factors such as predation and competition on the abundance of fauna and flora.

Experiments would be carried out by enclosing known abundances of organisms in contaminated and uncontaminated sediments in nylon mesh containers. Sediments with different amounts of oil could be used. The effects of the oil on biological interactions, such as predator-prey and competition, could be tested by using the appropriate experimental design. The results of these experiments would indicate numbers of individuals surviving under the different conditions of the experiment. Some references or persons to contact for experimental design are:

Woodin, S.A. (1971, Ecol. Monogr.) - The Johns Hopkins University

Disalvo (75 or 76) Env. Sci. and Tech.

John Lee and John Tietjen - CCNY

Bruce Coull - University of South Carolina

John Gary - Marine Research, Inc.

It might be of particular importance, regarding the problem of availability of personnel to study the effect of oil spills, to note that these experiments would require only a short time to set up and could be performed by persons otherwise involved in their own research.

3. - 6. Performing Organization; Applicable Habitats; Applicable Conditions; and Applicable Oil Type:

These experiments are applicable to all benthic habitats and could be performed by persons present at the institutions listed in other sections of this report. These experiments would vary in design in conjunction with the habitat, season, and animals or plants being studied. The effects of all types of oils could be analyzed in this manner.

7. Time Frame:

Studies of this nature could run over periods of days to months.

8. Cost:

The cost of caging studies would be relatively minor compared to that of survey work, possibly 10-25 percent.

9. Equipment Needs/Equipment Availability:

Equipment required in addition to that of the survey work would be that used in the construction of cages and the location of cages in the field (possibly electronic homing devices).

10. & 11. Facility Needs and Personnel Needs

See Benthic Projects 1 through 4.

12. Support Services:

Detailed analysis of the amount and kind of oil present in the experimental cages would be necessary.

13. Payoff:

The results of these experiments would provide insight into some aspects of the effect of oil on interactions between species and on the structure and function of benthic communities. It is this insight which is essential to the understanding of the effects of oil on the dynamics of communities and on the relationships between species of particular ecological or economic importance.

14. Limitations:

Experimental field apparatus must not be disturbed by people. Winter ice conditions might prevent the placement of cages in the field and these conditions or storms could cause their destruction.

MICROBIOLOGY AND BIODEGRADATION PANEL

Participants

A. Bourquin, Chairperson
C. Carty
C. Fredette
M. Griffin
F. Passman
R. Traxler

MICROBIOLOGY AND BIODEGRADATION PANEL

General Information

BACKGROUND CONSIDERATIONS

A. Areas of Interest

The panel listed research projects which the members considered important in the study of the fate of petroleum in the marine environment. After some discussion of each topic, the panel prioritized and grouped various projects. The summarized priority list in order of importance or benefit follows:

1. Biodegradation potential studies in surface films and sediments.
    a. Water column potential would become important only when dispersants are used.
    b. Baseline information is important and should be gathered as much as possible by current projects.
    c. Sampling techniques need evaluation or development.
    d. Heterotrophic potential - effects on degradation potential.
    e. Biomass determinations are important relative to hydrocarbon degrading microorganisms.
2. Physio-chemical degradation vs. microbial transformation and/or degradation.
    a. Methods for determining rates of degradation by physio-chemical and microbial degradation.
    b. Determine relationship of the two processes to a given oil in a given environment.
    c. Role of photochemical oxidation in further degradation by microorganisms.
    d. Role each process plays in anaerobic vs. aerobic systems (long-term fate).

3. Use of dispersants.
    a. Toxicity to hydrocarbon degrading microorganisms.
    b. Increased toxicity to other organisms and decreased degradation in water column.
    c. Microbial degradation of dispersants.
4. Increased pathogenicity to other organisms caused by selection of HC-degrading microbes.
    a. HC-degrading microbe is pathogenic.
    b. Increased susceptability due to stress on other organisms.
5. Formation of toxic metabolic intermediates.
    a. Toxicity to HC-degrading microbes.
    b. Toxicity to other organisms.

B. Other Subject Areas

The following areas of research were considered and either rejected for reasons given or reserved for later discussion:

1. "Seeding" of oil slicks is not a feasible method for degrading oil for the following reasons:
    a. Range of HC-utilizers in laboratory available for seeding is limited (no "super-bacteria").
    b. Cost of nutrient enrichment.
    c. Abundance of HC-degrading microbes in most environments.
    d. Low viability of freeze-dried populations.
2. Nutrient enrichment of natural populations for HC-degradation.
    a. Easy-to-degrade fractions are probably gone prior to fertilizing.
    b. Lower cost of mechanical techniques.

    c. Nutrients may not be limiting in surface microlayers or selected environments.

3. Baseline information - not enough information is available for New England in-shore areas.

    a. Improve and incorporate into current studies.

    b. Develop needed baseline information by sampling prior to spill coming ashore in a given area (expanded in topic discussion).

4. Anaerobic metabolism - incorporated into other projects.

Discussion on the benefits of assessing ecological damage or predicting the fate within a given environment follows:

C. Relevance of Biodegradation Studies

Biodegradation studies will provide:

- An index for predicting potential for hydrocarbon metabolism in a given environment (sediments and surface films).
- Monitoring tool for tracing biodegradation once a spill has occurred (sediments and surface).
- An index for effects on heterotrophic potential (metabolism of amino acids and carbohydrates).
- Prediction of toxic hydrocarbon fractions reaching the water column.
- Monitor changes in biogeochemical processes caused by oil intrusion into sediments or surface films.

Biodegradation studies are considered important on the following basis:

1. Microbial degradation is important in the fate of hydrocarbons from oil.
2. Evidence indicates that amino acid degradation potential can be correlated with hydrocarbon degradation whereas other heterotrophic potentials (carbohydrate) do not show this correlation.

3. Rapid analysis and relatively low cost.
4. Most oil fractions will be found in surface films or in sediments, with relatively little residence time in water column.

MICROBIOLOGY AND BIODEGRADATION PANEL

Recommended Projects

1. Effect of petroleum hydrocarbons on biodegradation potential and heterotrophic potential of marine and estuarine surface films and sediments.
2. Hydrocarbon assimilating yeasts as potential bioindicators of hydrocarbon pollution of marine and estuarine waters.
3. Dispersants toxicity to bacterial populations, particularly hydrocarbon degrading bacteria.*
4. Degradation in anaerobic sediments*.
5. Nutrient enrichment.

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*This project is currently in progress at URI.

PANEL: MICROBIOLOGY AND BIODEGRADATION
PROJECT NO. 1
PRIORITY RANK: 1

1. Project Title: Effect of Petroleum Hydrocarbons on Biodegradation Potential and Heterotrophic Potential of Marine and Estuarine Surface Films and Sediments

2. Project Description:

A. General

Information on the potential for a group of microbes in a given environment to degrade petroleum hydrocarbons could be used to predict the persistance of hydrocarbon films, and the availability of hydrocarbons to the water column and/or sediments. If the oil has a deleterious effect on the physiological functions of the microbial groups found in sediments or in the surface waters, changes in the indices (numbers performing metabolic function, total biomass) can be used to show this effect quantitatively. Additionally, data which correlates some "easy to measure" response in microbial populations to hydrocarbon potential can be used to help in predicting the fate of oil. The objectives of the study are twofold: 1) effect on hydrocarbon degrading potential, and 2) effects on heterotrophic potential. A somewhat detailed approach is included in order to standardize many techniques so that data can be better used in the final analysis.

B. Hydrocarbon-degrading potential

Some measures of the total heterotrophic bacterial population must be made. We suggest total viable counts on marine agar (1g peptone, 1g yeast extract) and a back-up method using LPS. In order to obtain an index of potential hydrocarbon degraders to total biomass, selected agar plates (containing 75-200 CFU's) will be replica-plated onto aged filtered sea water made with washed agar and various HC-substrates added:

1. Synthetic crude oil mixture containing representative aliphatics, aromatics, and cyclics - for total HC degraders.

2. Aromatic HC degraders - methyl-napthalene, + (another aromatic).

3. Cyclic degraders - incorporate a persisting cyclic hydrocarbon if possible, or t-decalin.

Confirmation of the hydrocarbon degraders and rates of oxidation can be obtained by ^{14}C-HC oxidation studies. Unaltered water and sediment samples are inoculated into:

1. sea water + crude oil (appropriate to spill) + ^{14}C - synthetic crude mixture - effects of crude oil on specific degradation.
2. ^{14}C-synthetic crude mixture + seawater - degradation rates of these three compounds.

Rates of ^{14}CO evolution from the ^{14}C-HC can be obtained relative to the total biomass showing correlation between the two experimental systems.

Samples should be obtained from surface microlayers (or slicks) by the Nucleopore method (Bourquin) whenever possible or by the alternate screen method if needed because of climatic conditions. Sediment samples should be obtained by aseptically subcoring from a Smith-McIntyre grab or box core. Care should be taken to reduce the disturbance of the sediment/water interface. (See heterotrophic potential description for sampling time.) These studies will provide a working index of hydrocarbon degrading potential and the changes occurring as oil resides in these environments. Coupled with some information on rates of oxidation, environmental conditions, oil type, and environmental nutrient levels, one should be able to predict with reasonable assurance the length of time a slick may survive or if toxic fractions will persist in surface layers, water column, or sediments.

C. Heterotrophic Potential

1. ^{14}C-labeled substrates
   U-^{14}C glutamate, U-^{14}C acetate and either ^{14}C-proline or ^{14}C phenylalanine (labeled in ring position).
2. Substrate mineralization rates will be determined from scintillation data. $^{14}CO_2$ evolved will be trapped and counted. Counts will then be converted to the units g substrate C/m^2/h.
3. Rates of glutamate, proline (or phenylalanine), and acetate mineralization will be compared with:

a. Mineralization rates for aliphatic, aromatic and cyclic hydrocarbons (determined during hydrocarbon degradation potential project).

b. Total and selective viable counts (determined during HC degradation potential project).

c. Bacterial biomass (LPS; determined during HC degradation potential project.

d. Sampling:

   1) Surface:

      i. calm seas (state ≤ 2) - Nucleopore membranes placed on surface from inflatable boat.

      ii. rough seas - Niskin bag sampler will be used to obtain new surface water sample.

   2) Sediment: Smith-McIntyre grab sample equipped with shroud to prevent contamination from oil slick at surface.

   3) Frequency:

      i. Surface:
         1. one set of 3 samples before oil intrudes.
         2. one set of 3 samples + 2 controls within 24 hours after intrusion.
         3. set of 3 samples + 2 controls once each week until slick is no longer visible.

      ii. Sediment: 1. and 2., as for surface.

Note: The following points 3-14 deal with heterotrophic potential while point 15 treats aspects of the biodegradation study.

3. Performing Organizations:

   A. Energy Resources Company, Inc.: Fred Passmand and Tom Novitsky (617/661-3111) capabilities summarized in Items 9 and 10 below.

B. URI - Richard Traxler: capabilities appear on another projects report.

C. UNH - Galen Jones (607/862-2250) probably interested; doesn't have facilities to respond at present.

D. EG&G - Mr. William Galen

4. Applicable Habitat:

Project applies to all marine and estuarine habitats.

The study can be modified to include most habitats except rocky or shell sediments. Surface layers and sediments will be the only areas considered because of a high probability for hydrocarbon contamination and degradation.

5. Applicable Conditions:

A. Numerous samples should be taken whenever possible to provide adequate statistical information for correlation with HC fate. The methods and techniques can be modified to meet most conditions and environments, i.e., dip surface samples in rough seas vs. membrane filters in calm seas.

B. Need sufficient notice to get to area for baseline observations before oil intrudes.

C. Heavy seas will preclude surface sampling, but new surface contingency plan is just as useful.

D. Due to elegant simplicity of protocol, experiments can be performed under wide variety of geographical and ecological conditions.

6. Applicable Oil Type:

Any type oil except very soluble fractions should be considered.

7. Time Frame:

A. Time required to collect complete set of surface and sediment samples (2-4 hours) depending on weather conditions and spill area.

B. Processing samples: 24 hours per set.

C. Interpretation: 2 weeks to a month after processing food samples.

D. Total time per spill: sampling - 100 mh
processing - 500 mh
interpretation - 100 mh.

(Computer technician/statistician and a microbiologist)

E. Size of spill will not appreciably affect these figures.

F. Additional information for proper correlation is needed whenever a spill occurs and can be assessed to have a high probability to move into a given area. We would need about 24 hours notice if possible.

8. Cost:

Does not depend on size of spill; however, it does depend on location of spill as ship time will comprise major fraction of total cost (estimated at $5000-6000 per day for ship time).

Costs for heterotrophic potential (exclude ship costs):

A. Isotopes - $10,000

B. Sampling - $ 3,000

C. Processing - $8,000 for isotope experiments
$2,000 for bacterial biomass
$5,000 for viable plate count of replicate experiments
(labor and supplies)

D. Interpretation and computer time - $3000

E. Total $31,000 Note: $10,000 estimate for radio labled hydrocarbons may be high or low depending on availability of labeled substrates.

9. Equipment Needs/Equipment Available:

A. Needs

No major equipment is needed to carry out the project. Radioisotopes can be purchased locally on short notice if not a special synthesis.

A good benthic sampler should be developed which would prevent contamination or disturbance of the sediment-water interface. A messenger shroud for the Smith-McIntyre grab sampler was proposed to prevent contamination of sediment samples with surface oil.

B. Available

1. Complete microbiology laboratory including epifluorescent microscope, scintillation counts, plus all standard laboratory equipment.

2. Field capability: inflatable boat equipped with 24 v outboard motor; 2 Smith-McIntyre grab samplers, a 1 m^3 box corer, 2 dozen Niskin bag samplers.

10. Facility Needs/Facilities Available:

An open ocean spill would require ship time and some laboratory time on board ship. Most work would be carried out in analytical labs on land. No special facilities needed.

ERCO's microbiology laboratory is complemented by an organic chemistry laboratory and trace metal laboratory. Gas chromatographs and a mass spectrometer are interfaced into a computer system. ERCO's team includes data management specialists, biostatisticians and computer programmers as well as industrial engineers with in-house capability of designing and manufacturing specialized equipment. The company has ready access to a small airplane, but does not have a sea going platform or mobile laboratory facility. As principle contractor for BLM's George's Bank OCS Benchmark, ERCO is accumulating a broad data base and expertise on the mid-north Atlantic region.

Facilities needed include: ship to transport investigators to off-shore areas and to provide a platform for sediment grabs.

11. Personnel Needs/Personnel Available:

Galen Jones - University of New Hampshire

Holger Jannash - Woods Hole Ocean. Inst. (He should be contacted concerning in situ benthic sampling and heterotrophic activities.)

Richard Traxler - University of Rhode Island

Fred Passman - Energy Resources Company, Cambridge, Massachusetts, 02138 617/661-3111

Most people can respond within 24 hours if radioisotopes are available.

12. Support Services:

Concurrent hydrocarbon chemical analysis of sediments and surface films are necessary for good correlation of microbial potential data with HC disappearance.

Physical data on water temperature, wind and current movements and Eh of sediments are required.

Micronutrient levels (N & P) are essential in predicting ultimate degradation levels. Toxicity data on pelagic fauna and in-shore benthic organisms would aid in ultimate predictions of hydrocarbons entering water or sediments.

13. Payoff:

This investigation has the same payoff as the hydrocarbon biodegradation project, with two added advantages: 1) radioactively labeled amino acids are considerably less expensive than radioactively labeled hydrocarbons, and 2) incubation periods required for amino acid experiments are on the order of 4 hours as compared with several days for hydrocarbons. Once the correlation between amino acid mineralization and hydrocarbon mineralization has been shown, we will have a tool for rapidly assessing the natural, standing bacterial populations potential for degrading hydrocarbons in the spilled oil.

14. Limitations:

The project does not answer the questions of ecological damage assessment directly. However, it does allow the predictions of recovery if enough information is gathered initially. It also helps the OSC in making decisions about cleanup operations because some information on rates and extent of degradation can be obtained within 24 hours after a spill.

15. Biodegradation Potential:

(3) Performing Organizations:

University of Rhode Island Oil Spill Research Team supported by an ERDA contract. Dr. Mason Wilson, Jr., Project Leader, Dr. R. W.

Traxler, Principal Investigator Biology and Dr. C. Ordzie, Research Associate for macro-biology systems. Dr. Chris Brown, P.I. Chemistry, Dr. T. Kim, droplet size distribution, Dr. Roger Dowdell, wind-wave interactions, Dr. M. Spaulding - modeling Principal Investigator.

(4) Applicable Habitat:

Various habitats, salt ponds, clam flats, offshore bottoms. Also spill sites of opportunity as a response function of the existing project.

(5) Applicable Conditions:

(6) Applicable Oil Type:

Crudes, No. 6, can do any petroleum.

(7) Time Frame:

Projected 3 year period.

(8) Cost:

(9) Equipment Needs/Equipment Available:

BOD capability about 300 determinations at any one time with increasing incubation over temperature range 0°C - 100°C. ^{14}C respiration system with air sweep and traps. Capability 24 samples/run. Run times up to 24 hours. Full spectrum of carbohydrates analysis.

Replicate plating capability - genus and predomance estimation capability by photographic means.

Amino acid and representative hydrocarbons by classes. Full capability for detection plate counts and membrance plate counts (up to 300 samples in triplicate, over a 3 log dilution range. MPN for about 300 samples. Limited capability for ATP analysis currently (estimate about 50 determination on a noncontinuing basis).

Sampling gear - in development phase - surface slick by two techniques are under consideration, water column by vacuum bag method. No satisfactory sediment system has been identified. May have to use typical samples.

Currently developing a liquid nitrogen sampling holding system so definitions analysis can be done at base lab rather than ship board.

(10) Facility Needs/Facilities Available

Three tanks at meso-scale size with 1 foot interval water column sampling - sediment trap.

Complete micro biology laboratory capability including aerobic and anaerobic systems, TEM and SEM support, general bacterial physiology methods.

Chemistry back up consists of GC-MS as well as special analysis.

(11) Personnel Needs/Personnel Available:

Full team capability represents 20 people. Contact Dr. Mason Wilson, Jr., 401/792-2330.

Microbiology team 4 persons contact Dr. Richard Traxler 401/792-2481. Biology Principal Investigator.

Biology (macro) Team includes two additional persons. A post-doctoral Research Associate, Dr. C. Ordzie and a technician available October 1, 1977.

(12) Support Services:

Chemical analyses (available)
Histological examination (probably available)
Modeling group (available)
Droplet size distribution (available)
Physical effects group (available)
Wind-wave indicator (available)

(13) Payoff:

This entire project provides biodegradation potential under controlled conditions and in situ for oil studies at surface, water column and sediment with various crude oil and petroleum products untreated and also treated with chemical dispersants. Dispersant treatment must respond to all three zones.

Can provide instant response for biodegradation determination by January 1, 1977, at a level of 25 samples - can expand on short notice to 100 sample capability.

(14) Limitations: (See Limitations for Biodegradation Potential.)

PANEL: MICROBIOLOGY AND BIODEGRADATION
PROJECT NO. 2
PRIORITY RANK: 2

1. Project Title: Hydrocarbon-Assimilating Yeasts as Potential Bioindicators of Hydrocarbon Pollution of Marine and Estuarine Waters.

2. Project Description:

A. Rationale

Reported oil spills in Connecticut alone during 1976 totalled over 200,000 gallons. This figure, while significant to the State, is small in comparison with areas such as the Gulf of Mexico, California, and regions subject to occasional major accidents (e.g., Torrey Canyon, Argo Merchant). Most concern has centered on the possible biological effects (toxicity, biodegradability) of oil in natural waters once the event has occurred. We have, in fact, been locking the barn door after the horse has gotten out; our assessment of the ability of natural, indigenous biopopulations to handle hydrocarbon spills is meager at best and these communities may be inadequate in numbers and/or degradative potential. Artificial "seeding" with known hydrocarbonolytic organisms may not be feasible. Rather, we should perhaps investigate the possibility of microorganisms with degradative activity to serve as indicators only of hydrocarbon presence instead of expecting them to totally biodegrade the spilled material. In this manner, the extent of a spill could be assessed and dealt with in an appropriate fashion (if one exists).

While bacteria have received the most attention with regard to natural degradation of oil spills in marine waters, a number of problems have been noted. Bacteria which are active in marine waters are usually stenohaline and are thus not efficient in estuarine or fresh waters. Also, certain hydrocarbons possess bactericidal or bacteriostatic components which require removal by natural or artificial means before the bacteria can biodegrade.

Certain species of filamentous fungi have been reported to degrade hydrocarbons; however, their relatively slow growth rates and restriction to certain salinities renders their biodegradation or bioindication potential questionable.

In fact, the yeasts may well provide a better potential than bacteria or other fungi. Long-term pollution of soil, freshwater, and marine habitats have produced unique yeasts capable of serving as indicators of petroleum addition. Also yeasts are tolerant of a wide range of salinity and temperature. It has been suggested that the ability of some yeasts to assimilate hydrocarbons could be useful in taxonomic studies.

Comparatively little attention has been applied to the matter of small, chronic, almost "accepted" petroleum spills in marinas, private dockages, and small fuel depots along coastal areas. For outboard motors, up to 55 percent of the original fuel can be discharged into receiving waters, although an average value is closer to 10-20 percent. The small scale addition of diesel fuel, gasoline, kerosene, motor oil, and other hydrocarbon containing materials at marinas, etc. through spillage, leaks, discarded containers, and run off renders the receiving waters subject to constant, low level influx of a variety of hydrocarbons, thus producing an environment conducive to the development of relatively high levels of hydrocarbonolytic yeasts.

Unfortunately, little information is available on the yeast microflora indigenous to Long Island Sound; our laboratory is the only active one in the area doing yeast research.

The project rationale may be summarized as follows:

1. Use areas of small-scale "chronic" petroleum introduction (marinas, etc.) as a source of yeasts characterized by hydrocarbon-assimilating ability. The assumption to be studied is that the presence of low (non-obvious) levels of hydrocarbons will stimulate populations of various hydrocarbon-assimilating yeasts in these waters.

2. Establish this relationship by surveying "clean" areas for the absence of these organisms in large numbers yet present at low densities.

3. Use techniques below and additional ones depending upon the genera and/or species found to recover them in marine and estuarine areas "unknown" with respect to hydrocarbon content; e.g., adjacent to a spill.

4. Application is made to classify waters adjacent to and well away from "known" sources of hydrocarbon introduction; waters not clearly polluted due to obvious spills. Hopefully, we will show gradients of hydrocarbon occurrence and areas not previously suspected of containing certain hydrocarbons.

5. Emphasis is placed not on biodegradation as such but rather on the hydrocarbon-assimilating ability of the yeasts to indicate the presence of hydrocarbon-containing waters and sediments - the development of a microbiological indicator of hydrocarbon pollution.

B. Objectives

To study the feasibility of utilizing hydrocarbon-assimilating yeasts as indicators of the presence of hydrocarbons in marine and estuarine areas. Since these organisms are not subject to extreme environmental stresses of varying temperature and salinity and are not particularly "territorial" in distribution, their presence, both quantitatively and qualitatively, in different coastal (and perhaps offshore as well) locales may be indicative of the occurrence of a variety of hydrocarbon-containing products (kerosene, diesel fuel, heating oil, etc.). Our approach is not to seek yeasts for potential large scale use as biodegraders *per se* but to use their ability to assimilate hydrocarbons as a tag for water masses containing the hydrocarbon substrate. Or put differently, we will attempt to show that it is possible to identify a pollutant in water by assaying the water for microorganisms associated with the utilization of the specific pollutant, or class of pollutants. In this way, a relatively uncomplicated microbiological monitoring system might be developed to allow for classification of coastal waters based on kind and amount of hydrocarbon present.

C. Procedures

A number of medium to large sized marinas will be selected for study in the Stonington-Groton-New London (Long Island Sound) area. In addition, we will attempt to gain sampling access to several small fuel depots located in the area. Several different types of materials will be sampled, depending on each individual site; e.g., oil-soaked soils in the vicinity of tanks, pumps, hoses; surface waters as close as possible to dock dispensing facilities; pilings and rocks. These areas, through a long history of constant hydrocarbon introduction, could be expected to select for microbial populations with hydrocarbon-assimilating characteristics. Samples of the various petroleum products available or stored at each site will be obtained for laboratory use. Water samples, solid substrata scrapings, soil, sediment, etc. will be cultured directly or diluted as appropriate on antibiotic-containing media selective for the growth of fungi. Both hydrocarbon-supplemented and unsupplemented liquid and solid media will be employed; in the latter case, the membrane filter technique will be used to concentrate yeast cells from water or other samples. Both broth and agar cultures will be incubated at or near ambient conditions. Colonies will be picked directly from solid media; liquid enrichment media will be streaked for colony isolation.

Several techniques will be used for the in vitro establishment of petroleum assimulating activity:

1. Basal medium (synthetic) containing artificial seawater, trace elements, and salts will be surface-inoculated with yeast isolates. Plates will be placed in sealed containers containing an open source of various volatile hydrocarbons (gasoline, etc.). Growth of yeast cultures will indicate a stimulation by petroleum products since fumes constitute the only available carbon source.

2. Certain hydrocarbons are not readily volatilized at low (laboratory) temperatures; these compounds will be assayed using the basal medium above inoculated prior to solidification (i.e., pour plates). Sterile filter paper discs, saturated with the petroleum product, will be placed on the surface of the plates. Colony growth near or around the disc is indicative of utilization of the product as a carbon source.

3. A more quantitative estimation of petroleum degradation can be obtained in liquid media. As above, an enrichment broth will be prepared with no carbon source. The petroleum product in question will be added aseptically in various concentrations. Growth (turbidity) of a yeast isolate will be measured spectro-photometrically.

4. In all cases, appropriate controls will be included. Also, microscopic examination of cultures will be routine since others have shown that, in some cases, yeast cells actively accumulate on the surface of, or even in, oil globules. This is an important point since it is essential, from an environmental standpoint, to differentiate between actual degradation and just emulsification.

All cultures isolated with petroleum-assimilating characteristics will be identified according to accepted procedures, allowing the determination of particular genera and/or species active in the presence of petroleum products. Also, petroleumphilic cultures will be cross-checked for the ability to grow in the presence of a variety of products; i.e., an isolate from diseal fuel soaked coastal mud will be examined for its ability to assimilate fuel oil, gasoline, keroscene, etc.

To establish clearly the association of petroleum-assimilating yeasts with the hydrocarbon substrate, we will examine suitable "control" areas; e.g., rocks, pilings, sediments, water, etc. at considerable distances from any known source of hydrocarbon contamination. by comparison of microbial responses from the different areas, we will seek to detect a distinct hydrocarbon-assimilating population of yeast association with the presence of the chemical substrate.

Having delineated this population, a set of microbiological tests will be evaluated for specific detection of these yeasts in "unknown" areas; i.e., waters contiguous with and at varying distances from known sources of hydrocarbon pollution (fuel depots, tander docks, etc.). Eventually, natural waters subject to spills may be "hydrocarbon-classified" by the presence of absence of the yeasts sought in this study.

3. Performing Organizations:

   University of Connecticut, Marine Sciences Institute, Marine Research Laboratory - Dr. John D. Buck, Associate Professor of Biology (Microbiology).

4. Applicable Habitats:

   Initial work involves shoreline and near-shore habitats. Subsequent application may be made to off-shore locales.

5. Applicable Conditions:

   Probably not a significant factor.

6. Applicable Oil Type:

   Probably any type hydrocarbon.

7. Time Frame:

   The project would require probably two years to establish the assumptions herein.

8. Cost:

Salaries & Wages	$14,000	
Direct & Indirect Costs	10,000	
Equipment (1st yr only)	10,000	
Supplies	2,000	
Other	1,500	
Approx.	$37,500	(first year)

9. Equipment Needs/Equipment Available:

A. Needs:

Initially, a large variable temperature incubator will be required.

In addition, several roller drums are needed for culture incubation.

B. Available:

Complete microbiology laboratory with standard equipment; skiffs and motors for coastal sampling.

10. Facility Needs/Facilities Available:

All covered with present facilities

11. Personnel Needs/Personnel Available:

A. Needs:

Graduate student--Research Assistant; should be covered by an incoming student in the fall (September) semester.

Hourly help-usually available from pool of undergraduate or graduate students without additional financial support.

B. Available:

Dr. John D. Buck (Principal Investigator) - available for full time work June-August; 30-35 percent of time September-May.

12. Support Services:

Not applicable

13. Payoff:

The possibility of assessing the geographical extent of any spilled hydrocarbon in a variety of waters (estuarine, marine). Hopefully, the ability to map the vertical and horizontal scope of a spill will be enhanced. Other than obvious indications (slicks, dead organisms, etc.) the real limits of an accident are unknown. Dilution, wave action, currents, tides, etc. may well disperse a hydrocarbon beyond (or below) the limits of visual (or even chemical) detection. This project may offer an alternative of greater sensitivity.

At the very least, we will obtain information on the microbiological aspects of chronic hydrocarbon degradation will be expanded, particularly with respect to "cross-reaction" with a variety of pollutants. In addition, we will increase our knowledge of the abundance and distribution of hydrocarbonolytic yeasts in a variety of individual habitats characterized by the presence of a broad scope of petroleum substrates acting as selective and enrichment nutrients for particular groups or species.

14. Limitations:

The project could be considered as gathering baseline or background information and may thus be rejected or reserved on this basis. Nonetheless, "before" preceeds "after" and the data generated are planned to be applicable once a spill has occurred.

PANEL: MICROBIOLOGY AND BIODEGRADATION
PROJECT NO. 3*
PRIORITY RANK: 3

1. Project Title: Dispersants Toxicity to Bacterial Populations, Particularly Hydrocarbon Degrading Bacteria.

2. Project Description:

   A. To determine whether dispersants promote or inhibit biodegradation of hydrocarbons, the project will monitor in situ microbial activity and biomass before impact, after impact, before treatment with dispersant, and after treatment. Sampling in an untreated region of the spill will provide control data if possible. Otherwise, data from similar spills for which dispersants were not used will serve as "control".

   B. Parameters to be monitored are:

      1. Heterotrophic potential as determined by mineralization of C-labeled substates.

      2. Bacterial biomass as determined by LPS concentration.

      3. Total and hydrocarbonoclastic (viable count as determined by membrane filter and replicate plating techniques).

      4. Change in lipid:carbohydrate:protein:nucleic acid (RNA) ratios as a function of impacting oil or dispersant.

      5. Presence of exo-enzymes or metabolites induced by dispersants.

   C. Sampling:

      1. Surface film

      2. Near surface water column-using Niskin bag samplers

      3. Bottom sediments

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*This project is currently in progress at URI.

D. More detailed descriptions of methods for monitoring the listed parameters and sampling have been provided in other projects proposed by the group, and are not elaborated here. Support from organic chemists will be required for parameters 4 and 5.

3. Performing Organizations:

Energy Resources Company - The multi-disciplinary scientific and managerial support team at ERCO is described in Project No. 1. Key personnel are Fred Passman and Tom Novitsky at (617) 661-3111.

Galin Jones (UNH) is doing some work on siderochrome production by marine bacteria. This project might be of interest to his group. 607-862-2250

Richard Traxter (URI) - His group's capabilities have been described elsewhere.

4. Applicable Habitat:

As with the other microbiology projects, minor modifications in the sampling protocol make the project applicable to all New England aquatic habitats.

5. Applicable Conditions:

Mechanical dispersion of the oil slick by heavy seas would seriously impair the chances of getting meaningful results. If there is no chance of obtaining control data from previous spills or an untreated fraction of the current spill, interpretation of the results would be tenuous at best. Accordingly, seas ≤ 2, spill area of sufficient size that a region of the spill could be left untreated, and a pre-spill period during which laboratory experiments would be performed on candidate dispersants are all important to the success of the investigation.

6. Applicable Oil Types:

Heavier oils, crude oils would be the best suited for this type of study since use of dispersants is probably best justified for such spills.

7. Time Frame:

A. Sampling: 16mh/sample set (6 surface, 6 water column and 6 sediment samples/set).

B. Sample Processing

1. Radio-nucleides experiments	4mh/set	16mh
2. LPS assay	1mh/set & setup	5mh
3. Viable count & replicas	18mh/set & prep	80mh
Total		100mh
4. & 5. Organic Chemistry Support	?	200mh

C. Interpretation 80mh

D. Summary: Sampling will be completed during the first 2 weeks of the spill/treatment event. Processing will require about 3 months exclusive of the organic chemistry which may take as long as 6 months. Final report should be prepared within 9 months of start of investigation.

8. Cost:

A. Materials: Isotopes + Media + Membranes + Reagents	$2,000
B. Processing:	$2,000-5,000
C. Interpretation & Computer Times:	$2,000-2,500
D. Transportation, platform costs-depends on location and geography of spill site	$1,000-30,000

9., 10., and 11. Equipment, Facilities, Personnel:

Equipment, facilities, and personnel have been described in detail in Project No. 1.

12. Support Services:

Biochemical assays described above. Physical data on dynamics of air-ocean interface and slick migration. Data on vertical migration of micelles formed due to treatment is important. Also needed is information from organic chemists on rates of hydrocarbon speciation change in micelles.

13. Payoff:

As with the other microbiology projects, the primary benefit of this study is to provide a means for rationally selecting the optimum technique for minimizing the ecological and socioeconomic impacts of an oil spill. If it can be demonstrated that dispersants enhance biodegradation of oil by increasing surface area, etc., then use of dispersants would be indicated for at least some oil spills. If dispersants are toxic, cause production of toxic metabolites, or cause no enhancement in biodegradation rates, then other recovery techniques are preferred.

In terms of damage assessment, once the initial studies are completed, metabolic rate studies will provide a relatively rapid, inexpensive and statistically significant means of assessing the efficiency of cleanup efforts, as well as long-term impact on affected environments.

14. Limitations

The most serious limitations have been suggested:

A. A background of information from laboratory experiments is needed to ensure success of a field study.

B. Dispersants are not routinely used in the U.S. If dispersants were used to treat an oil spill, some means would have to be devised to preserve an untreated portion of the spill for control studies.

PANEL: MICROBIOLOGY AND BIODEGRADATION
PROJECT NO. 4*
PRIORITY RANK: 4

1. Project Title: Degradation in Anaerobic Sediments

2. Projection Description:

   To determine if hydrocarbon degradation does occur in anaerobic sediments, and if so, at what rate. Using standard petroleum crude oils (API reference Kuwait, South Louisiana and Bunker C) determine which components are degraded. Physical-chemical degradation must be identified as compared to biodegradation. The study should also determine if oils in anaerobic sediments have a negative, positive or no effect on physiological processes in anaerobic sediments such as sulfate reduction or nitrate reduction.

3. Performing Organization:

   University of Rhode Island, Department of Plant Pathology - Entomology and Department of Microbiology, Dr. R. W. Traxler in cooperation with Dr. C. Brown of the Department of Chemistry, EG&G - Mr. William Galen.

4. Applicable Habitats:

   Offshore bottoms, sand shores; worm-clam flats; salt ponds.

5. Applicable conditions:

   Uncontaminated sediment which can be oiled by standard reference oils. There are no weather or climatic conditions which would prevent the study. Oiled sediments from Argo Merchant or other spill sites, with similar unoiled sites for reference. Weather limitation associated with sediment sampling, such as sea state.

6. Applicable Oil Types:

   Standard reference oils would be preferred due to existing analyses but any product could be used.

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*This project is currently in progress at URI.

7. Time Frame:

The study would require a 3-year time frame to ensure that low degradation rates are not missed in the analysis scheme. Replicate samples would require 1-week testing periods each month for up to 24 months, unless rates are established in shorter time frames. Chemical analyses would represent 3 days per month.

8. Cost

In this project there is no relation between cost and spill size. Cost would be calculated at personnel, supply, and equipment base of about

2-part time personnel	$12,000
Overhead and fringe	6,000
Initial equipment	10,000
Expendable support	4,000
Total	$32,000

9. Equipment Needs/Equipment Available:

10. Facility Needs/Facilities Available:

11. Personnel Needs/Personnel Available:

12. Support Services:

13. Payoff:

14. Limitations

PANEL: MICROBIOLOGY AND BIODEGRADATION
PROJECT NO. 5
PRIORITY RANK: 4

1. Project Title: Nutrient Enrichment.

2. Project Description:

   To determine 1) if nutrient enrichment has a significant stimulatory effect upon hydrocarbon oxidation rate and percentage of hydrocarbon oxidation by microbial populations as compared to non-nutrient enriched systems, and 2) if nutrient enrichment has potential adverse environmental effects such as over production of microbial or other biomass.

   The experiment can be carried out in meso-scale environmental systems utilizing a natural seawater control tank, an oil treated tank and an oil treated tank supplemented with oleophilic nitrogen and phosporus nutrient supplements. Biodegradation potential can be determined using biomass and rate determinations and correlated via chemical analyses for rate of component degradation.

   It is anticipated that degradation rates will be increased but that the increase in biomass will result in other problems of environmental significance. More degradation products will appear in the water column than in nonsupplemented systems.

3. Performing Organizations:

   The University of Rhode Island Oil Research Group supported by an ERDA contract to study treated vs. untreated oil spills has the capability to respond to this problem. The MERLE project group at URI/GSO also has the capability from a facility standpoint, as well as EG&G through Mr. William Galen. Dr. Richard Bartha, Rutgers, is an expert in the field of nutrient enrichment, and may be consulted on questions in this area.

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

8. Cost:

9. Equipment Needs/Equipment Available:

10. Facility Needs/Facilities Available:

11. Personnel Needs/Personnel Available:

12. Support Services:

13. Payoff:

14. Limitations:

BIRDS AND MARINE MAMMALS PANEL

Participants

J.L. Dunn, Chairperson
B. Baxter
B. Blodget
J. Cardoza
J. Harris
F. Heppner
T. Hoehn
A.M. Julin
C.L. Knapp
K. Powers
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R.F. Randall

BIRDS AND MARINE MAMMALS PANEL

General Considerations and Guidelines

- Background Information on Birds
- Preliminary Panel Considerations
- Recommendations to the Workshop Executive Committee
- Laws Concerning Marine Mammals and Birds in EPA Region I
- Recommended Procedures for Processing Specimens
- General Procedures for Assessing Damage to Birds

BACKGROUND INFORMATION ON BIRDS, MAMMALS AND REPTILES

A. Population and Inventories

Populations of coastal and marine birds in EPA Region I have been addressed in Drury (1973-1974), Nisbet (1973), Brown et al (1975), Brown (1977), and Powers (manuscript being developed for U.S. Fish and Wildlife Service based on an 18-month Georges Bank study by Manomet Bird Observatory). Most of the above work deals with breeding populations on the New England and eastern Canadian seaboard, and to a lesser extent on pelagic distributions. The Fish and Wildlife Service also is presently cataloguing all colonies of coastal and marine birds from Maine to the Carolinas, and developing estimates of total breeding pairs.

Temporal and spatial distributions of species have been described in the above-listed publications.

B. Critical Habitats

Coastal critical habitats are far better understood than critical pelagic habitats. W. Drury (College of The Atlantic), I.C.T. Nisbet (Mass. Audubon Society), Brian Harringon (Manomet Bird Observatory), Michael Erwin (U. of Mass., Coop. Wild Res. Unit) are the authorities on coastal critical habitats in EPA Region I. Kevin Powers (Manomet Bird Observatory) and R.G.B. Brown (Canadian Wildlife Service) are the present authorities on pelagic distributions of marine birds in

EPA Region 1. The previously mentioned publications deal with critical habitats to some extent, but communication with above persons will provide specific unpublished information on certain families of birds and areas in the Region.

C. Facilities, Personnel and Areas of Expertise

Massachusetts Audubon Society - I.C.T. Nisbet (Terns and gulls), R. Foster

Manomet Bird Observatory - Brian Harrington (Shorebirds), U. Powers, R. Veit

Boston University/Museum of Comparative Zoology (Harvard University) Tim Rumage (Seabirds and Avian Pathology)

University of Massachusetts Cooperative Wildlife Research Unit - Michael Erwin (Waders and coastal birds)

College of the Atlantic - William Drury (Gulls and seabirds)

Massachusetts Division of Fish and Wildlife - Brad Blodgett, H.W. Heusmann

U.S. Fish and Wildlife Service Regional Office (see Appendix F)

State Conservation Agencies in Maine, New Hampshire, Connecticut and Rhode Island

Pelagic birds

Manomet Bird Observatory - Kevin Powers (seabirds)
College of the Atlantic - William Drury (seabirds)
University of Rhode Island - Frank Heppner (Trigom report compiler)

D. Available Impact Information

Substantial information exists on past impact on bird populations of certain spills throughout the world. The most important accidents are summarized in a chapter by W.R.P. Bourne on Seabirds and Pollution in Marine Pollution, ed. R. Johnston, Academic Press (1976). However, most information on ecological impacts deals with abundance and species diversity from birds that have been picked up on "beached bird surveys" of affected coastlines. Quite a bit of information deals with methods of cleaning and rehabilitating oil contaminated plumages. Long-term effects on bird populations have not been dealt with. Both short-term and chronic studies of the dietary effects of oil on waterfowl are underway at the Patuxent Wildlife Research

Center, Laurel, Maryland. Information from the Argo Merchant incident dealing with beached bird surveys and pelagic surveys of oil contaminated birds will be dealt with in a publication by K. Powers (MBO) by January 1978.

Likely effects of future spills on coastal and pelagic birds include:

(1) Direct mortality due to physical oiling of plumages.
(2) Indirect mortality by ingestion of oil, either directly or indirectly through food chains.
(3) Effects of external and internal oiling on reproductive success, during applicable seasons.
(4) Effects on wintering or breeding habitats of oil reaching shoreline habitats. Breeding, feeding, loafing habitats may be altered.

E. Background Reports

1. A Socio-Economic and Environmental Inventory of the North Atlantic Region (Including the Outer Continental Shelf and Adjacent Waters from Sandy Hook, New Jersey to the Bay of Fundy). Vol. 1, Book 4. Submitted to the Bureau of Land Management, Marine Mammals Division, November, 1974. TRIGOM/PARC, Public Affairs Research Center.

Available From:

TRIGOM
Box 2320
So. Portland, ME

2. Oil Spill Prevention and Response. Report to the Massachusetts Interagency Task Force on Oil Spills. Executive Office of Environmental Affairs, Publication No. 9705-185-30-5-77-CR. April, 1977.

3. Massachusetts Breeding Bird Atlas. Five year project (1974-1978) to determine distribution of breeding birds in Massachusetts. Joint project of Mass. Audubon Society and Mass. Division of Fisheries and Wildlife. In preparation for eventual publication.
Contact: B. Blodget (MDFW), R. Forster (Mass. Audubon).

4. U.S. Fish and Wildlife Colonial Seabird Nesting Survey. Three year project (1975-1977) to furnish baseline data on colony occupancy and distribution in Coastal North America. To be published.

Contact: Dr. Wendell E. Dodge and R. Michael Erwin, Mass. Coop. Wildlife Research unit, 204 Holdsworth Hall, University of Mass., Amherst, MA 01002

5. Winter Waterfowl Surveys (for Massachusetts). Job progress reports published under Pittman-Robertson Projects W-35-R, W-42-R, and other State and PR projects. Coverage-ca. 1950 to date.
   Contact: H.W. Heusmann, Mass. Division of Fish and Wildlife, Field Headquarters, Westboro, MA 01581
   Regional compilation by U.S. Fish and Wildlife Service.

6. Nisbet, I.C.T., 1973. Terns in Massachusetts: Present numbers and historical changes. Bird-banding 44(1):27-55.

7. Drury, W.H. 1973. Population changes in New England Seabirds. Bird-banding 44(4):267-313.

   ____________ 1974. Population changes in New England Seabirds. Bird-banding 45(1):1-15.

F. Wildlife Inventories

Birds:

1. Griscom, L. and D.E. Snyder, 1955. Birds of Massachusetts. Peabody Museum, Salem, Mass. 295 pp. Discussion of history and annotated list of species.

2. Barley, W., 1955. Birds in Massachusetts, PP for Mass. Audubon Society.

3. Barley, W., 1968. Birds of Cape Cod National Seashore. Mass. Audubon Society. Annotated list.

4. Hill, N.P., 1965. Birds of Cape Cod. W. Morrow and Co., New York, 364 pp.

5. Griscom, L. and E.V. Floger, 1948. Birds of Nantucket. Harvard University Press, Cambridge, 156 pp. Information local, but largely dated.

6. Griscom, L. and G. Emerson, 1959. Birds and Martha's Vineyard. Privately Printed, Martha's Vineyard, Mass., 164 pp. Information local but largely dated.

7. Blodget, B. Annotated list of birds of Massachusetts. With Seasonal Abundance and Distribution. In prep.

8. Resource Management Plan. Phase 1 RB1. For Cape Cod National Seashore (1976).
Contact: P. Godfrey, Dept. of Botany, Morrill Hall, University of Massachusetts, Amherst, MA 01003

Mammals:

1. Cordoza, James E., 1976. Preliminary List of Mammals of Massachusetts. Mass. Division of Fish and Wildlife. Mimeo. Unannotated list of mammals of the state. Distribution and abundance of land mammals.

2. Godin, A.J., 1977. Wild mammals of New England. Johns Hopkins Press, Baltimore, 304 pp. Detailed description, by species, of distribution and natural history of regional mammals.

3. Leatherwood, S., D.U. Caldwell and H.E. Winn. 1976. Whales, dolphins and porpoises of the western North Atlantic. A guide to their identification. NOAA (NMFS), NOAA Tech. Rept. NMFS Circ-396, 176 pp.

Reptiles:

1. Lazell, J.D., Jr., 1974. Reptiles and Amphibians of Massachusetts. (2nd ed.) Mass. Audubon Society, Lincoln, 34 pp. Annotated with brief comments on distribution and abundance.

2. Lazell, J.D., Jr., 1976. This broken archipelago. Quadrangle Press, New York, 260 pp. Distribution, abundance and history of reptiles and amphibians in Barnstable, Dukes, and Nantucket Counties, Mass.

3. Bleakney, J.S., 1965. Reports of marine turtles from New England and Canadian waters. Canadian Field Nat. 79(2):120-128.

4. Frair, W. 1972. Leatherback: northward, ho! Aquasphere, New England Aquarium 6(3):12-15.

PRELIMINARY PANEL CONSIDERATIONS

A. Critical Habitats and Species Inventories

It became apparent to the panel that time limitations would not permit a cataloguing of critical habitats and a species inventory. Panel members were asked to suggest available published reports which would provide this information. Several such reports were on hand

and several others were suggested. Of special interest were the Manomet Bird Observatory's Final Report to the U.S. Fish and Wildlife Service on the spatial and temporal distribution of marine birds at Georges Bank and adjacent waters, and a recent Trigom Report which attempted to describe the distribution of marine mammals in New England Outer Continental Shelf. It was the consensus of the panel that identification of habitats critical to birds and marine mammals is one area of baseline information which is sorely lacking. There is a substantial lack of confidence in currently available data. Throughout the panel's discussions, a consistent theme was the lack of baseline data. These gaps in our knowledge cast doubts upon the validity of any studies aimed at assessing the damage to marine mammals and bird populations in the area of oil spills. The panel was unanimous in its recommendation that EPA should undertake major efforts to support research designed to fill these gaps. In areas outside its normal purview, EPA should attempt to make certain that appropriate agencies are aware of the requirements for research in such areas. [An area not encompassed by the Workshop is the impact of oil spills on marine and estuarine reptiles. The Panel feels this is an unfortunate oversight and has attempted to make reparations by including references on marine reptiles and a project dealing with effects of oil pollution on marine reptiles.

B. Project Areas

1. Recommended Projects

The panel identified several projects which it feels will aid in assessment of oil damage to marine mammals and bird population in its region. These projects include:

- Survey of birds and marine mammals in the area of an offshore oil spill.
- Near-shore survey of birds and mammals.
- Collection, classification and salvage of suspected oil impacted wildlife. (Includes histopathology, toxicology, physiology, and causes of mortality.)
- A study to develop methods to determine actual mortality from post-spill mortality observation.
- Behavioral observations on wildlife in and around an oil impacted area. (Includes observations on both impacted and non-impacted animals.)

- Long-term follow-up of the impact of an oil spill on birds and marine mammals.
- Determination of the impact of cleanup operations on birds and mammals.
- Development of methods to minimize adverse impact of cleanup operations.

The panel initially considered one project in depth, a survey of birds and marine mammals in the area of an oil spill. After completing this exercise, our initial impression--that projects involving high cost platforms must be piggybacked with other projects--was strengthened.

2. Other Subject Areas

Other areas that are not suitable for development as projects but that require further investigation are:

- Identification of Federal, state and local agencies which may have jurisdiction over a particular species in order to avoid conflict between these agencies or between these and other agencies.
- Identification of current Federal, state or local laws which may delay or prevent execution of required studies.

RECOMMENDATIONS TO THE WORKSHOP EXECUTIVE COMMITTEE

The following formal recommendations are made to the Executive Committee:

1. In a field as esoteric as marine mammology, the numbers of individuals in a given EPA region attending an oil spill workshop may not be adequate to provide the required expertise to produce the information requested of the panel. We feel that EPA should consider funding a national workshop designed to produce the required information. In December there will be a meeting in San Diego dealing with marine mammals. This meeting will be attended by most of the nation's marine mammologists. One additional day at such a meeting could be devoted to assessing oil spill damage in marine mammals. By piggybacking on this meeting, the cost of assembling the required information would be extremely low whereas the information acquired would be maximized.

2. In future workshops birds and marine mammals should not be lumped together. The only common ground between these two groups is the fact that they are homeotherms and may exist in the same areas. Close coordination of projects developed by separate panels is of course highly desirable.

3. The panel suggests the creation of a permanent advisory body to assist the agencies in development of data collection and analysis methods.

4. The requirement for rapid response to an oil spill makes it unlikely that equipment needed for proposed studies will be either immediately available from an institution or immediately available for purchase. For these reasons, the panel suggests the Executive Committee consider the establishment of two or more sites where equipment pertinent to routine oil spill studies can be stored ready for immediate shipment to the scene of a spill. A coordinated nationwide scientific program suggests that certain equipment will be necessary no matter where the spill occurs. Establishment of equipment depots on each coast is a more cost-effective mechanism than funding such equipment purchases for a dozen researchers nationwide.

LAWS CONCERNING MARINE MAMMALS AND BIRDS IN EPA REGION I

A. Massachusetts

Subject to the provisions of existing Federal statutes, the Massachusetts Division of Fisheries and Wildlife (MDFW) of the Department of Fisheries, Wildlife, and Recreational Vehicles has jurisdiction over wild birds, mammals, and inland fish within the bounds of the State Legislation to extend jurisdiction to include reptiles and amphibians is pending. The Division of Marine Fisheries has jurisdiction over marine fish and shellfish, and, equally with the Division of Fisheries and Wildlife, over marine mammals. In addition to any Federally required permits, individuals or agencies wishing to conduct investigations involving collection, capture, harassment, marking, etc. of state-protected species should request a permit for that purpose from: MDFW, Leverett Saltonstall Building, Government Center, 100 Cambridge Street, Boston, Massachusetts 02202; 617-727-3151. The Division of Marine Fisheries customarily waives their permit requirement for bona-fide investigators holding valid Federal permits. They may be reached at the above address, telephone 617-727-3196.

The MDFW also has legal authority to conduct investigations on wildlife within the above classes of vertebrates. Whether or not such researches are conducted, and to what extent, is dependent on policy, funding, and training and availability of personnel and equipment.

Statutory authority for the above is contained in Chapter 130, Sections 1, 17, and 101A (Marine Fish and Chapter 131, Sections 4 and 5 (Fisheries and Wildlife) of the Massachusetts General Laws, and related laws and regulations.

B. Connecticut

Under state law it is illegal to take birds without permit. Statute 26.60 provides for scientific and educational permits. Statute 26.54 states that it is illegal to possess live birds without a custodian permit. Migratory birds and marine mammals require Federal permits from U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service.

It is recommended that:

1. Researchers work with existing permit holders, e.g., wildlife biologists, universities, etc.
2. Permit requests be addressed to: Connecticut Department of Environmental Protection, Wildlife Unit, State Office Bldg., Hartford, CT. The request should explain species, times, purpose of collection.

C. Federal

Laws governing Federal responsibility for migratory birds include:

- Migratory Bird Treaty of 1918, as amended.
- National Oil and Hazardous Substances Pollution Contingency Plan, issued in the Federal Register by the Council on Environmental Quality on February 10, 1975, as amended in 1976 and 1977.

The Migratory Bird Treaty gives responsibility for managing migratory birds to the U.S. Fish and Wildlife Service and states. This includes issuance of Federal and state collection and possession permits. The regional contact for Federal permits is:

Wayne Sanders
U.S. Fish and Wildlife Service
Newton Corner, Mass.
617-965-5100

Federal permits may be approved by phone for those competent to collect, possess and handle birds.

The "National Contingency Plan" (1510.22) provides that DOI will provide (f) "expertise to OSC and RRT with respect to land, fish, wildlife resources under its jurisdiction"; (m) "making resources available for Federal pollution response operations"; and under 1510.46 (b) "arrange for and coordinate actions of professional and volunteer groups that wish to establish bird collection, cleaning and recovery centers", and "to the extent practicable, identify organizations or institutions that are willing to operate such facilities."

GENERAL PROCEDURE FOR ASSESSING DAMAGE TO BIRDS

A. Immediate Direct Damage to Individual Organisms and Populations

(1) Assess total populations (density estimates) of each species in area of spill and monitor on at least a weekly basis (daily during spring or fall migratory periods) to measure possible movement of specific populations to and from the affected area.

(2) Estimate damage to specific populations by determining percentages of each species that show visible oiling on their plumage and by beached bird surveys.

(3) Utilizing density estimates in area and percent of specific populations that were contaminated, estimates of immediate direct damage to specific bird populations may be developed.

B. Indirect, Delayed or Chronic Damage to Bird Populations

These assessments require accurate information on the composition and characteristics of the spilled fuel. These needs are discussed under specific recommended projects.

(1) Determine the source or origin (e.g., breeding colony) of contaminated bird species (includes direct and indirect mortality) to enable assessment of population losses at selected breeding locations. Birds from both the Northern and Southern Hemispheres are involved.

RECOMMENDED PROCEDURES FOR PROCESSING SPECIMENS*

1. Dead Animals

a. Advanced autolysis - place animal in freezer

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*Specimens should be handled according to EPA chain of custody procedures.

b. Recently dead

- tissue samples in 10% buffered formalin for histological purposes; Vol. of the formalin must exceed 10X vol. of tissue.

- tissues for hydrocarbon analysis* (e.g., blubber, muscle, liver, brain, gut). Sample size depends on precision desired. Tissue must be packaged according to appropriate CF. FR 40(28) Pt.11 pp. 62-97 guidelines. Volume of tissue should be 100g or better.

- necropsy of animals to determine cause of death.

c. Frozen specimens, not decomposed

- handle hydrocarbon analysis as in b above.

2. Moribund Animals

a. Liver samples - 10g or more should be obtained. If mixed function oxidase levels are desired, must go into liquid nitrogen ASAP.

b. Blood samples - 5 cc of blood in EDTA and 20cc of blood, no anticoagulant. Refrigerate and centrifuge to separate serum. Remove serum from packed cells. Serum can be frozen for future analysis.

Make 2 thin smears from EDTA sample; air dry.

Reference for sampling tissues

Patuxent Wildlife Research Center, Laurel, MD
USFW Service National Wildlife Health Labs, Madison, WI

3. Gut Contents - remove for analysis of ingested hydrocarbons, food items, or empty. Many collected specimens may be emaciated and starved.

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*Techniques for analysis of hydrocarbons in warm blooded animals, although still under development, are currently useful in determining if an organism has been exposed to oil pollution.

BIRDS AND MARINE MAMMALS PANEL

Recommended Projects

1. Assessment of immediate impact on bird populations in area of offshore oil spill.
2. Breeding bird population studies.
3. Collection, classification and salvage of suspected oil impacted birds.
4. Effects of oil spills on bird reproduction.
5. Determination of spill associated bird mortality from post-spill body counts.
6. Assessment of the impact of an oil spill on marine mammals.
7. Summary of birds and marine mammals for offshore oil spills.
8. Assessment of oil spill damage to New England marine turtle populations.

PANEL: BIRDS AND MARINE MAMMALS
PROJECT NO: 1
PRIORITY RANK: 1

1. Project Title: Assessment of Immediate Impact on Bird Populations in Area of Offshore Oil Spill

2. Description of Project:

A. Objective - Determine species composition, density, and distribution of bird populations in area of oil spill, and the proportion of each bird species which is visibly contaminated with oil.

B. Procedure

(1) By aerial surveillance the species composition, density, and distribution of bird populations in the area of the spill will be estimated using a fixed-wing aircraft flown over a pre-selected grid to randomly sample bird populations present on contaminated and adjacent areas. This technique involves using 2 observers and one recorder (in addition to the pilot) in a twin-engine hi-wing aircraft flown at 100 feet above sea level at 100 mph. All birds within a 300m transect will be counted by species for 10-minute periods. Densities (birds/km2) will be extrapolated using species abundances per area sampled [300m wide x (10 min x air speed)]. This technique is being utilized by the USFWS - OBS/CE, 800 A St., Suite 110, Anchorage, AK 99501 - Project Leader - Calvin Lensink.

(2) Determine percent of each species visibly contaminated with oil from shipboard surveys by using 10-minute counts of total numbers of each bird species within sight of the ship (Brown et al. 1975 - Atlas of eastern Canadian seabirds, and Manomet Bird Observatory unpublished cruise reports). Specific formats for sampling and compilation of data on computerized data sheets are discussed in the references above. Behavioral observations and notes on the degrees (i.e., light, medium, or heavily oiled) of plumage contamination and areas of body affected (i.e. nape of neck, breast, belly, etc.) will be recorded in the 10-minute count format.

(3) Utilizing density estimates determined from aerial surveillance and percents of specific populations visibly contaminated from concurrent shipboard surveys, estimates of immediate direct damage to bird populations can be made.

3. Performing Organization:

A. Offshore spills - Manomet Bird Observatory 617/224-3559 - Kevin Powers or Brian Harrington. This organization presently has the capability and available manpower to perform such a study.

B. Possible performing organizations suggested: College of the Atlantic - 207/288-5015 - William Drury; University of Rhode Island - 401/792-2372 - Frank Heppner.

4. Applicable Habitats:

All offshore habitats in EPA Region I (i.e., Gulf of Maine, Georges Bank, shelf waters South Cape Cod, and Rhode Island, OCS slope waters).

5. Applicable Conditions:

Presence of bird populations in area of spill. The only conditions necessary for completion of study are the use of aircraft and surface vessels able to contend with weather/climate and geographical conditions. Ecological conditions with the bird component of the ecosystem are strictly limited to ocean surface and air strata. An organization like Manomet Bird Observatory can presently supply trained manpower to meet study requirements with internal funds for one week. Equipment such as aircraft and surface vessels must be supplied.

6. Applicable Oil Type:

Any oil type or group of oils.

7. Time Frame:

Inclusive period of short-term assessment requires period from oil spill to one month after spill has visibly dissipated and can no longer be traced by air. Daily to weekly surveillance flights depending on season of year will be necessary. One-week sampling periods per month from shipboard surveys will be necessary. Depending upon size of spill more than one survey ship may be necessary. Sample work-up and data analysis requires an additional 2 months per year. Note: This time frame does not consider any long-term effects.

8. Cost:

A. Aircraft - $100 per hour.

B. Surface vessels - range $500 - $3000 per day, 7-10 days on study area per vessel desired.

C. Personnel

(1) Aircraft - 2 observers and 1 recorder per flight.

(2) Surface vessels - 1 observer.

Extra cost of Manomet Bird Observatory observer = $100 per day (includes salary ($12K/year) and 57% overhead) - does not include travel and per diem costs.

D. Equipment - (may sometimes be provided by certain institutions or agencies, but for this project proposal it is assumed that the NRT will provide necessary equipment).

(1) Photographic - $2000 per kit. One kit includes: SLR 35-mm camera with motor drive and data back; 200-400 mm zoom lens with gunstock mount; 10 rolls @ 36 exp Tri-X film; 10 rolls @ 36 exp. Plus-X film. (One kit per aircraft and surface vessel needed.)

(2) Cassette tape recorders @ $75 (one recorder per aircraft and surface vessel needed).

(3) Optics - 1 pair 8 x 40 WA binoculars @ $75 (1 pair per observer needed).

(4) Film processing - grossly estimated at $1000.

E. Automatic data processing, if necessary. Key punch and statistician's time grossly estimated at $1500 for a spill of similar size and duration as Argo Merchant incident.

F. Phone, Xerox, etc., costs (if University-based study) grossly estimated at $500.

G. Principal investigator - salary range, \$15 - \$25K per year. Mean - \$20K per year. Daily consultant rates based on USFWS scale = $\frac{\text{salary per year}}{260}$ Daily pay rate = \$77 per day.

Based on one month duration spill and three months' data analysis and report writing - 4 months with 20 working days per month = 80 days.

\$77 x 80 = \$6160 total P.I. salary.

P.I. at 33% of time for 4 months = \$2033.

9. Equipment Needs/Equipment Available:

A. As this project is largely observation orientated, little equipment will be required beyond optical and recording materials. One kit with the following materials will be required for each crew (aircraft or ship):

(1) single lens reflex camera with data back and motor drive unit

(2) 200-400m 200m lens w/gunstock attachment

(3) cassette tape recorder with tapes

(4) 8X40 binoculars

B. All these materials are potentially available through the appointed institutions, but are not guaranteed to be accessible at the moment of a spill. Therefore, kits should be prepared in advance.

10. Facility Needs/Facilities Available:

Facility needs involve aircraft and ship transport:

A. Aircraft - hi-wing, 2 engine, float equipped preferred, VFR/IFR, deicing, communications, and navigational capability appropriate to pelagic survey, room for two observers, recorder, and pilot.

B. Surface Vessels - from 1-3 vessels of similar design or observational capability, range and construction suitable to open ocean work in poor sea conditions for 10-day minimum (port to port); location electronics equal to Loran A or better; VHF radio with sea-air, sea-sea, sea-land capability;

lifeboat or skiff with capability in cabin to moderate seas; berth for 1-2 observers.

11. Personnel Needs/Personnel Available:

Discussed in parts 3 and 8(C).

The principal investigator and associates chosen from list of performing organizations will delegate staff for the project.

12. Support Services:

A. Relevant long-term and cause-and-effect studies can be associated with and after this study. Base line data necessary for background and more accurate ecological assessments are discussed in part #14 (Limitations).

The following studies should be considered in priority listed:

(1) Recovery, rehabilitation and salvage operations during spill.

(2) Indirect mortality by ingestion of oil, either directly by preening or indirectly through food chain. What are the chances of survival for a lightly oiled bird? Can we assume any bird that ingests oil will die? What are external and internal toxicity levels?

(3) Effects of external and internal oiling on reproductive success (long term and short term).

(4) Effects of habitat degradation or alteration (wintering, breeding, or migratory stopover habitats; whichever is applicable to bird species in question). Habitat aspects to be considered are feeding, loafing, nesting, etc.

13. Payoff:

A. The study will provide capability to clearly respond to public sentiment regarding impact on bird populations. More specifically, it addresses:

(1) estimates of direct mortality per bird species at spill site

(2) probable estimates of indirect mortality due to spill

(3) limitations in estimating long-term or more accurate assessments are discussed in part #14 (Limitations).

14. Limitations:

A. Our capability to assess environmental damage to marine bird populations associated with these spills is dependent on necessary base line information.

B. These populations are highly mobile. Even with the best base line data present capabilities can provide, statistically significant measurements ($P<.05$) may not be possible.

C. Weather and sea state may severely disrupt the effectiveness of the project.

D. Initial counts of direct mortality at spill site may be misleading. Oiled birds may die many miles away, may sink before being counted, may float out to sea unobserved (opposed to washing ashore). They also may be more likely to be counted because of behavioral factors (flight and feeding characteristics; spending more time on water). All oiled birds may not be contaminated from same source.

E. Cost predictions listed for this study may not be considered feasible (e.g., aircraft and vessel costs) with available funds. Most of these high-cost facilities necessary, may be dove tailed with USCG operations and other research groups. However, the quality of data collected may be reduced. To what extent data quality will be impaired is unknown.

PANEL: BIRDS AND MARINE MAMMALS
PROJECT NO: 2
PRIORITY RANK:

1. Project Title: Breeding Bird Population Studies to Monitor Population Fluctuation at Breeding Colonies and to Study the Relationship of Such Fluctuations to Oil at Sea

2. Project Description:

This project takes a long-term approach to monitoring changes and trends in sea populations. It provides invaluable base line data, material that ideally should have been generated 20 years ago. Only in seabird rookeries are the populations concentrated in space and time to the extent that accurate and meaningful population estimates can be made. Therefore, this approach should provide a most sensitive measure of population fluctuations--some of which may be attributable to oil spills. The Torrey Canyon disaster demonstrated the value of this approach in the British Isles where considerable surveys of the seabird resources have gone on for many years. Actual percentage drops in the populations could be measured by noting declines at the rookeries. This proposed project would be international in scope and would be quite expensive. Some data are already available (cf. Canadian F. & W. Survey of the Seabirds colonies in eastern Canada; USFWS, Seabird Survey; U. of Maine Coop. Res. Unit and U. of Mass. Coop. Res. Unit, Dr. R. Michael Erwin and Wendell Dodge, P.I.)

3. Performing Organizations:

The enormous scope of this project makes it essential to utilize all available observers and cooperators. These would probably represent various organizations contracting with a lead-coordinating agency - e.g., USFWS or The Seabird Group. Dr. William Drury, College of the Atlantic, Bar Harbor, Maine, has considerable expertise in the Region I seabird population. The only known reference for Canada is the Canadian Wildlife Service.

4. Applicable Habitats:

Offshore islands, sandy beaches and bare cliffs, stacks, ledges, and wherever seabirds are found to be nesting.

5. Applicable Conditions:

Successful completion would depend on availability of necessary manpower, operation platforms and equipment. The huge scope of the project means that these factors might, in fact, be limiting. Necessary men and equipment would need to be highly coordinated to correspond/coincide with the seabird meeting chronologies. Accuracy of data generated would be limited by weather, sea conditions, difficulties associated with landing on offshore islands, etc.

6. Applicable Oil Type:

Not directly applicable.

7. Time Frame:

A. Total scope of project: minimum 10 years.

B. Annual scope of project:

(1) Field Operation May - July.

(2) Equipment Preparation/Data Processing August - April.

8. Cost*:

A. Personnel

Principal Investigator (1) @ $250-300/week for 25 weeks	$ 6,875**
Field Observers (12) @ 80-100/week for 12 weeks	13,000**

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*For this section, cost estimates are based on survey and observation of all seabird colonies in Massachusetts. Cost for total NE Maritime Region would be expanded Province by Province, with highly variable costs expected due to different colony access problems and requirements. For example, Newfoundland would require large boat and much off-shore work, while in Massachusetts, small boats and vehicle work would be adequate.

**This figure reflects all staffed, agency-filled positions and doesn't take into account the probability that some personnel are volunteers or personnel already on the job, e.g., P.I.

B.	Operating Platforms	
	16' Boston Whaler, rented or chartered @ $100/day, boat trailer included, for 8 weeks, fully-equipped	5,600
	2 4x4 Scout International Jeeps at $50/day for 12 weeks	4,200
C.	Equipment	
	(a) Binoculars (6 pairs) 8x40 Swift @ $120 each	720
	(b) Spotting telescope and tripod @ $200	200
D.	Contingencies (e.g., telephone calls, beach permits, notebooks, etc.)	350
		$30,570
		or $32,000

9. Equipment Needs/Equipment Available:

A. Binoculars, Swift 8x40 or 7x50 (about 6 should be available for use)

B. Telescope, Bausch & Lamb Bolscope Sr. 20 power, 300MM (1)

C. Tripod (1)

10. Facility Needs/Facilities Available:

A. Boat (1) Boston Whaler, 16' fully equipped and C.G. inspected ideal.

B. Trailer for Boat (1)

C. Trucks (2) 4x4 Scout International equipped with 7.50 x 15 tires with psi = 17, low-pressure tire gauge, air-tank (capy 200 lbs.), hydraulic jack, tire iron, several boards, shovel, spare tire, come-along; 25 feet 1/2" nylon rope or equivalent strength cable.

D. Garaging for vehicles assumed to be covered by owning agencies, e.g., MDFW, Wbo. hdqtrs or SE District Office, etc. No additional cost involved.

E. Docking/launching facilities for boat. Arrangements in advance at appropriate points of departure. Possibly some cost involved here not shown in Paragraph 8 above.

11. Personnel Needs/Personnel Available:

A. For Massachusetts, possible Principal Investigators:

Dr. R. M. Erwin, U. MA. Coop Res. Unit, Holdsworth Hall, Amherst, MA 01003 (presently USFEW Coordinator or on MA Coast for Seabird Survey).

Bradford G. Blodget, State Ornithologist, Mass. Div. F. & W., 100 Cambridge Street, Boston, 02202. Tel. (617) 727-3151. Home No: (617) 853-5474 at 74 Hillcroft Ave., Worcester. Currently co-coordinator of Division activity on tern project.

Richard Forster, c/o Mass. Aud. Soc., leader of MA tern project.

B. Current additional observer personnel furnished by other agencies, e.g., Trustees of Res., Parker R. NWR, MAS, Cape Cod Nat. Seashore, Barnstable Conserv. Comm., and volunteers too lengthy a list to give here.

C. Adequate personnel are available on short notice. Names and details available from any of above individuals or agencies listed (for MA only). Personnel would have to be lined up and coordinated state by state or province with a state or provincial coordinator.

12. Support Services:

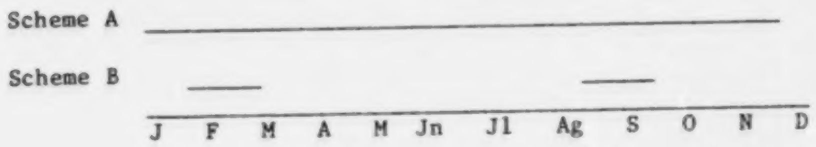
A. Aerial reconnaissance of study area helpful in surveying for locations of colonies to be censused. All actual census work to be carried out from land and water-based platforms. Aerial data are useful only in locating breeding colonies.

B. Studies on census techniques might help refine methods of obtaining accurate numerical estimates.

13. Payoff

Payoff would be in long range build-up of data to be used as a barometer of change in seabird numbers. Immediate use for determining damage due to spills would be minimal, but the study could yield excellent general population data after sufficient time (probably at least 10 years). Yields current information on sea-bird numbers in total population that cannot be obtained in any other fashion and therefore potentially very useful in assessing long range trends--some trends in part possibly due to oil contamination at sea. The long term oil related mortality in seabirds may be greater than the spectacular one-shot mortality immediately associated with spills.

Figure 1. Two schemes showing seabird mortality due to oil. In Model A, mortality is scattered over a wide area, as birds encounter oil at many small spills, or individual globs of oil and die. In model B, there is spectacular loss at a spill site. However, over the long range, actual mortality under scheme A may be much greater than that associated with B. The proposed project would give a much better assessment of the seabird resource picture at control concentration points, where birds congregate from the oceans of the world. Over time, these two types of mortality might appear thus:



Scheme B takes into account only concentrated, visible oil mortality; scheme A takes into account continuous, non-point oil mortality.

This discussion gives the major payoff, which may be the only long term solution to assessment of damage being done.

14. Limitations:

A. Financial limitations would probably be most severe. Hence, the project could be broken down into state or provincial programs that would capitalize on local experts familiar with their areas to minimize the associated costs.

B. Project does not give a direct cause-effect relationship between oil at sea and impact on seabird numbers. Rather the proposed project shows fluctuation in seabird numbers resulting from a large assemblage of factors.

C. Project has little or no value in short-term assessment of damage at the site of an oil spill. Benefits are entirely based on long-term development.

D. Project may be limited severely in some states or provinces by any or all of the following factors:

(1) difficulty of access to remote colonies,

(2) lack of competent observers, and

(3) impossibility of documenting number of birds in colonies due to difficulties in obtaining accurate number estimates.

E. Projects would apply only to colonial nesters (see point 15).

15. Species Affected:

A. The following colonial nesters would be most easily assessed by this project:

(1) Dovekie

(2-3) Murres (2 spp)

(4) Razorbill

(5) Black Guillemot

(6) Gannet

(7) Black-legged Kittiwake

(8) Puffin

(9-10) Cormorants (2 spp)

B. The following species may all be assessed, but may be less critical as they might be more affected by other factors than oil.

(1) Tern spp. (NE and north, 4 spp)

(2) Gulls (NE and north, 6+ spp)

C. The following species are highly colonial, but colonies are geographically very remote from our area:

Cory's Shearwater (Azores, the closest)

Greater Shearwater (Tristan Archipelago)

Sooty Shearwater (sub-Antarctic islands)

Wilson's Storm Petrel (sub-Antarctic islands)

Atlantic Fulmar (Northeast Atlantic)

D. The following pelagic species are non-colonial and would require different censusing techniques:

Oldsquaw, Scoters (3 spp), Eiders (2 spp) Loons (2 spp), Grebes (2 spp).

Addendum to Project No. 2:

The spatial and temporal distribution of the marine bird-populations in OCS New England waters is only superficially understood. Only one 18-month study (USFWS-Manomet Bird Observatory) has examined pelagic distributions of birds in this area. Yearly trends have not been investigated. A viable census technique for counting birds at sea has been developed, and a format for automatic data processing of such information is available. A prototype ADP program is currently being developed and tested by U.S. Fish and Wildlife Service Migratory Bird and Habitat Laboratory at Laurel, Maryland. Data processed in this format was collected at the site of the Argo Merchant spill and will be analyzed by January 1978. We have capitalized on a unique offshore research opportunity. The existence of a spatial and temporal distribution data will allow more accurate estimates of probable import of future spills. The mobility of seabird populations makes this data base necessary for valid damage assessments.

The seabird populations that utilize U.S. Northwest Atlantic OCS waters involve species from Tristan De Cunha, Antarctic Peninsula, and South Shetland Islands in the Southern Hemisphere; and species from northwest Africa, the Canaries, Azores, Shetland and Faroe Islands, Iceland, Canadian Arctic islands, Newfoundland, Nova Scotia, and New England in the northern Hemisphere. A spill may have a devastating effect on a particular breeding population or may involve a small percentage of several breeding populations. We simply do not know this information and therefore cannot really assess the actual damage because it may not be apparent until the birds are thousands of miles away. We can obtain better information with collecting and banding operations on an international scale.

We do not know, but may only conjecture from the literature, what food resources the seabird populations utilize in these waters. Studies in the literature are few and were investigated in other countries mainly during the breeding seasons. Damage (i.e. resource reductions) or contamination of prey items may seriously affect bird populations. A depleted prey species may act as a severe stress on bird populations, or hydrocarbon accumulations in prey species may result in a detrimental build-up of hydrocarbons which may kill individual birds when otherwise stressed; or when toxic tissue levels are reached from contaminated prey items (i.e., fish in Mississippi River drainage resulted in extermination of all breeding populations of this species along coastal Louisiana in the early 1960's).

In conclusion, we may well be able to assess mortality at the site of the spill with a comprehensive effort as stated in this project, at a phenomenal cost, but we cannot make any meaningful statements concerning an ecological assessment of damage until we have a data base with which to compare results obtained during damage assessments studies.

PANEL: BIRDS AND MARINE MAMMALS
PROJECT NO: 3
PRIORITY RANK:

1. Project Title: Collection, Classification and Salvage of Suspected Oil Impacted Birds

2. Project Description:

A. Objectives

(1) Collect distressed and dead birds in and around an oil spill, including adjacent on-shore areas.

(2) Transport collected specimens to a control processing point.

(3) Classify specimens into categories of living vs. dead, oiled vs. non-oiled.

(4) Record appropriate site and specimen data, including species, sex and age, condition, date, time, location.

(5) Coordinate disposition of specimens for treatment under allied projects.

(6) Necropsy of dead animals.

B. Techniques

(1) Land-based collection: regionalize shoreline and associated inland areas. Assign a regional coordinator (and assistants if necessary) to each region. (Reference: Cardoza, J.E., 1977. Oiled bird recovery program for the "Argo Merchant" Spill. Typescript memorandum to the Director of the Mass. Div. Fisheries and Wildlife. 10pp. Provide a central coordinator. Regional collectors would be responsible for patrolling their area, collecting the specimens, and transporting them to a central point. Based on Argo Merchant experience, regions may be 3-5 miles in length (depending on numbers of birds involved and accessibility of terrain). Patrolling at least twice a day, but capable of expansion. Nightlighting as applicable.

(2) Water-based collection: regionalize coastal (up to 1/4 mile off-shore) areas. Assign regional coordinator and assistants. Same central coordinator as (i)

above. Patrol daily (capable of expansion). Provide at least one off-shore/on-spill collection crew, as necessity requires and conditions permit.

(3) Classification: central coordinator and assistants examine specimens collected by regional crews, make status determination, record applicable data, package specimens for distribution.

(4) Salvage: central coordinator liaisons with allied investigators to provide for transportation and distribution of specimens. Follow recommended EPA chain of custody procedures. Procedures for handling specimens apply.

3. Performing Organizations:

A. Lead: U.S. Fish and Wildlife Service (name & address of coordinator) and state fish and wildlife department(s) of state(s) in area of spill (for Mass., contact Matthew B. Connolly, Jr., Director, Mass. Div. Fish & Wildlife, 100 Cambridge St., Boston, Mass. 02202, 617-727-3151).

B. Secondary: local conservation and humane organizations; local scientific and educational institutions; municipal conservation commissions/civil defense departments.

4. Applicable Habitats:

Pelagic; rocky shore; sandy shore; salt marsh; and salt pond.

5. Applicable Conditions:

A. Physical accessibility of on-shore terrain.

B. Permissible accessibility of area (e.g., bombing ranges, hazardous area).

C. Sea state ≤ 4 ft. for water-based collection.

D. Presence or immediate potential presence of birds in subject area.

E. Availability of collection personnel and associated transport.

F. Requirement for specimen disposition.

6. Applicable Oil Type

All types or groups of oils.

7. Time Frame

Duration of spill, plus period during which capturable/collectible oiled birds continue to appear.

8. Cost:

A. Equipment:

Vehicle, 4x4 - .20 per mile
ATV - $1.00/hr of operation
Vessel/boat - $100 per day
Shipping boxes- $1.75 per box
Burlap bag - .15 per bag
Plastic bag - .20 per bag

Nets - $5-$8 per net
Goggles - $5.00 per pair
Gloves - $5.00 per pair
Spotlight - $10.00 each
Scale - $50.00 each
Expendables- $50.00 each
Utilities - $250-$500/mo. for facilities

B. Personnel:

PI-$100/day salary, plus $35 per diem
Others-$75/day, plus $35 per diem.

C. Operating Cost for One Month Operation

1. P.I. Salary + cost (1)	$ 4,050,00	
Other personnel (20)	45,000.00*	
2. Vehicles (based on about 6 vehicles, travelling 5,000 mi. at .20/mi O.C.)	1,000.00	
Boats (2) (based on $100/day/boat)	6,000.00	7,120
ATV's (1) (based on $1.00/hr of operation, at 4 hrs/day)	120.00	
3. Equipment:		
Shipping boxes 500x1.75 e	875.00	
Bags, burlap 500x.15 e	75.00	
Bags, plastic 500x.20 e	100.00	

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*Based on assumption all personnel are brought in by agency involved. It is likely the breakdown of personnel would include volunteers.

Nets, 12x$5 or $8	60.00 to 96.00
Goggles, 12x$5	60.00
Gloves, 25x2 = 50x$5	250.00
Spotlights (on trik) 6x$10	60.00
Scale	50.00
Expendables	100.00
4. Utilities (heat, tele., elec.)	200.00 to 500.00*
Rental of collection center (if necessary)	300.00 to 500.00
	58,500.00

9. Equipment Needs/Equipment Available:

A. Truck or utility vehicle, 1/2 to 3/4 ton, 4x4. One per 3-5 mi. shoreline plus one 2x4 or 4x4 truck for central coordinator.

B. ATV/ACV. One per 3-5 mi. shoreline inaccessible by vehicles in (A) above.

C. Collapsible waxed cardboard pheasant shipping boxes, or equivalent. One per bird.

D. Burlap sacks, new or washed. One per bird.

E. Landing net, 8 ft., nylon bag, wooden or aluminum handle. One per collection crew plus reserve supply.

F. Goggles, work gloves, elbow-length rubber gloves. One set goggles per collection crew and 2 gloves per man plus reserve supply.

G. Spotlight (narrow beam, candlepower). Vehicle-mounted or hand-held. One per truck.

H. Scale, suspension, dial-reading, with pan, 15Kg capacity. One.

I. Plastic bags, heavy-duty, approximately 36x18 in. One per bird.

J. Expendables: labels, markers, writing materials, twine, etc.

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*Variable, due to season.

10. Facilities Needed:

A. Collection point. Enclosed building, seasonally usable, with adjacent parking area, and ample space for processing and temporary storage of live and dead specimens in warm weather. Land line and CB/RT Commo.

B. Surface vessels: One per shoreline or sq. mi. surface area. Length 18-25 feet, deck working space, enclosed cabin. Smaller craft (whaler) availability as substitution or supplement for equivalent shoal/shallow water/harbor areas.

11. Personnel:

Principal investigator and associates selected from list of performing organizations (see #3) will delegate staff or requisition volunteers from secondary organizations.

A.	Central coordinator (PI)	1
B.	Assistants	1-3
C.	Regional Coordinators	1 per vehicle/boat
D.	Assistants	1-2 per coordinator

12. Support Services

A. Necropsy, histopathological, chemical analyses of impacted or suspected impacted dead specimens. Includes superficial, ingested, and absorbed contaminants.

B. Rehabilitation of potentially recoverable live specimens.

C. Coordination of collection efforts with on-shore and close in-shore surveys of distressed birds.

D. Coordination of collection efforts with on-shore and close in-shore surveys of distressed birds.

13. Payoff:

A. Distressed birds are one of the most, if not the most, visible indicators of disaster in an oil spill. The resultant surge of emotional public response demands equally visible recovery efforts - despite the frequently questionable biological grounds for such efforts. Public support or resistance for all phases of spill studies may be keyed to the favorable or adverse publicity generated by recovery operations.

B. Collection of impacted specimens will provide a known (albeit minimal) tally of bird losses from a spill.

C. Collection of impacted (and control) specimens will provide samples for initiating determination of the physical and physiological effects of oil on birds.

14. Limitations

A. Weather, sea state, and terrain may limit the effectiveness of collection efforts.

B. Collection of live specimens dependent on mobility of live birds, skill of collectors, terrain accessibility, extent of holding facilities, extent of interference by unsolicited help, and degree of predation on distressed birds.

C. Collection of dead specimens is dependent on at sea flotation time, terrain accessibility, and degree of scavenging by predators.

D. Utility of specimens is dependent on preservation facilities for dead specimens, and holding facilities and transport for live specimens.

E. It should be recognized that this method does not necessarily provide an estimate of total loss, but only a tally of known collected losses.

COMMENT ON PRIORITY

Allied projects will depend on this project for the collection and distribution of specimens, e.g., tissue analysis, blood sample collection, etc. Hence, this should be ranked high. This is not to mention the high public relations importance of this type of project.

PANEL: BIRDS AND MARINE MAMMALS
PROJECT NO: 4
PRIORITY RANK:

1. Project Title: Effects of Accidental Oil Spills on Bird Reproduction

2. Project Description:

Effects of contamination on yolk formation, localized in the ring structure of avian egg yolks, are easily distinguishable from other environmental variables and would provide a good diagnostic index of an oiling effect during egg formation. If this can be taken as an exposure index, other data on ovarian and testicular structure and function, embryonic development, hatchability, clutch size, and subsequent growth and survival of young can be related quantitatively to oil exposure. Yolk variation with respect to oil contamination can be quantified in lab experiments and this information later could be applied to field samples to determine the level of exposure. Field samples of birds and eggs, and other data, will be collected during and after the spill throughout the breeding season.

References:

Grau, C. R. 1975. Ring structure of avian egg yolks. Department of Avian Sciences, University of California, Davis.

Grau, C. R. 1977. Altered egg structure and reduced hatchability of eggs from birds fed single doses of petroleum oils. Science (in press).

3. Performing Organization:

C. R. Grau and T. E. Roudybush
University of California, Davis
Department of Avian Sciences

4. Applicable Habitats:

Depends on species impacted.

5. Applicable Conditions:

A. Oil spills impacting on seabirds, waders, or waterfowl.

B. During breeding season.

6. Applicable Oil Type:

All types.

7. Time Frame:

Two months after the end of the breeding season--roughly 3-8 months.

8. Cost:

Salaries	- $4,600
Travel and Per Diem	- $9,000
Lab and Equipment	- $4,000
Total	$17,600

9. Equipment Needs/Equipment Available:

The majority of the equipment is lab equipment in the UC Davis Lab.

10. Facility Needs/Facilities Available:

Possible fixed wing aircraft or helicopter and quarters for field personnel. These could easily piggy-back with other projects and facilities.

11. Personnel Needs/Personnel Available:

A. Requirements

3 field biologists

1 lab biologist

part time Principal Investigator

B. Persons to Contact

C. R. Grau	916/752-3535	office
	916/752-1300	dept.
	916/753-4349	home
T. E. Roudybush	916/752-1300	dept.
	916/758-2626	home

Alice Berkner
International Bird Rescue Research Center
Aquatic Park
Berkley, California

12. Support Services:

    A. Continued laboratory studies of effects of oil on yolk structure

    B. Baseline data on bird reproduction

13. Payoff:

    A. Quantification of exposure

    B. Impact on reproduction related to exposure.

14. Limitations:

    A. Only few investigators/labs capable of doing this.

    B. Does not in itself yield total effect on a population.

    C. Can be done only during the breeding season.

    D. Proven only on geese and laboratory animals--may not work with wild birds.

PANEL: BIRDS AND MARINE MAMMALS
PROJECT NO: 5
PRIORITY RANK:

1. Project Title: Determination of Spill Associated Bird Mortality from Post-Spill Body Counts

2. Project Description:

For assessment of liability and determination of damages in an offshore spill incident, it will be important to know actual spill associated bird mortality. This information cannot be obtained directly by counting dead birds in the spill area, because some bodies will sink or drift away from the spill area. Knowledge of the fate of dead oiled birds and actuarial techniques based on knowledge of currents could provide a means of predicting actual mortality, if current data were available in the spill area.

A. Project Objectives:

(1) Determine floating times for various seabirds oiled with the major oil types, and;

(2) Develop a model and actuarial tables for calculating the mortality given the time of body count, characteristics of the sampling techniques, and basic oceanographic data.

B. Basic Experimental Design:

(1) Floating times of oiled birds
Mallard ducks will be sacrificed, and their feathers oiled with a standard quantity of each of the test oils. The bodies will be placed in a temperature controlled seawater wave tank and tested under the following conditions:

winter temperature and summer temperature
calm, 1 ft. sea and 2 ft. sea

Observations will be made by photographing the tank every 2 hours. When a bird is 1 ft. below the surface, it will be counted as "sunk" and 10 birds/condition will be used.

(2) The statistician and oceanographer will cooperate in developing a computer model which will predict mortality when the following factors are known:

a. area of spill
b. current
c. tides
d. wind
e. number of live birds counted on transects
f. number of dead birds counted on transects
g. sink rate of dead birds
h. other factors to be determined

(3) Verification of the model and sink times will be provided by taking sacrificed, oiled birds on ships of opportunity, placing them in a floating "trap" which will be easily visible, and recording rate of sinking over several days.

3. Performing Organization:

Any organization which has in-house expertise in ornithology, statistics, and machine processing of data, and physical oceanography should be able to handle this project. WHOI, URI-GSO immediately come to mind. Expertise in ornithology is the least important aspect.

4. Applicable Habitat:

Primarily offshore

5. Applicable Conditions:

This is primarily a laboratory simulation, so completion is largely a matter of funding and facilities rather than environmental factors. Verification and validation of the actuarial model can be made on ships of opportunity.

6. Applicable Oil Type:

Each of the common offshore cargoes; Crude, #2, #4, #6, Bunker C, would be tested.

7. Time Frame:

Month	Floater Experiments	Simulation Model
1	organization, construction	1&2 construction of
2	of apparatus, securing of specimens	model
3	start of exp.	3--no work
4	exp.	4--no work
5	exp.	5--no work
6	exp.	6--no work
7	field confirmation of model	7--incorporation of floater data writing
8	exp. field confirmation of model	8--
9	reduction of data	
10	writing	
11	writing	

8. Cost:

This estimate assumes a university contract. Industry will be higher.

A. Personnel

P.I. (20k/year) summer salary	$4,200
Oceanographer-engineer summer salary	$4,200
Statistician-summer	$4,200
Technician (full time 9 mos.)	$7,200
Lab helper (full time 9 mos.)	$5,000
	$24,800
Overhead	$14,000

B. Capital Equipment

tank	$5,000*
"trap"	500
	$5,500

C. Supplies

livestock	$900
chemicals	300
glassware	200
misc.	100
	$1,500

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*would not be needed if existing one available

D.	Computational Time	$1,500
E.	Travel-Per Diem for Ship Trials	$400
F.	Publication expenses, secretarial, telephone, postage	$500
	TOTAL	$48,200

9. Equipment Needs/Equipment Available:

The primary piece of equiment is a wave tank. Various university mechanical and ocean engineering departments have such tanks, but their availability depends on time of the year, other projects, etc. A tank could be constructed using standard techniques if none were available at the time of the project. A floating "trap" to hold dead birds for the field trials would have to be constructed. Small amounts of glassware, lab supplies, etc., would be needed.

10. Facility Needs/Facilities Available:

See 9 and 2 above.

11. Personnel Needs/Personnel Available:

P.I. full time summer, 1/4 time for 9 months
Actuary-statistician 1/4 time for 6 months
Ocean engineer-physical oceanographer 1/4 time six months
Technician-full time for 9 months
Lab helper-full time for 9 months

12. Support Services:

This project is in support of other project.

13. Payoff:

This project has an immediate payoff in determining much more accurately than now, the possible number of birds killed in a spill. Since it is likely that liability judgments will be based on $/bird, this data will be essential in the adjudication process. From a scientific standpoint, knowledge of the fate of dead birds, and an assessment of mortality will help to determine the short and long term impact on populations.

14. Limitations

Limitations include the fact that not all sea and weather states can or will be simulated in the laboratory. The study also will not include considerations of those birds which ingest oil, fly elsewhere and die. What it will do is narrow the confidence limits of mortality predictions.

PANEL: BIRDS AND MARINE MAMMALS
PROJECT NO: 6
PRIORITY RANK:

1. Project Title: Assessments of the Impact of an Oil Spill on Marine Mammals

2. Project Description:

A. Data Gathering Techniques

(1) Aerial surveys to identify local populations, distributions and relative abundance of marine mammals in the area of a spill.

(2) Shipboard and/or shore surveys as above to confirm involvement of marine mammals and oil

(3) Collection of obviously fouled marine mammals for necropsy or physiological sampling and debilitated animals for rehabilitation and release.

(4) Tagging of affected but otherwise healthy appearing animals (includes use of radio tags and tracking and photographic identification of individual animals.

B. Cleaning of Oiled Marine Mammals

(1) Initiation of clean-up operations

As oiled marine mammals are identified, efforts should be made to clean affected individuals. As yet, there is no established method for removing oil from various impacted animals. A methodology should be delivered and recommended for implementation in the event of a spill which affects marine mammals populations.

(2) Monitoring of cleanup acitivities

Since cleanup operations have never been conducted on N.E. marine mammal populations in connection with an oil spill, effects of the cleanup operation itself should be carefully monitored. This involves investigating:

(a) the effect of cleaning and no cleaning agent on individuals and;
(b) effect of overall cleanup activities on population and community structure, and

(c) habitat utilization.

With respect to the effects on the individuals, cleaned animals should be tagged so that subsequent monitoring phases can lead to the determination of the apparent success of employed cleaning operations in terms of the survival of cleaned individuals.

In the case of the cleaning operation's effects on the community as a whole, inter and intra-population associations should be observed to investigate any behavioral modifications associated with human intervention.

The redistribution of populations associated with oiled habitat should also be observed and changes in habitat utilization noted.

C. Anticipated Results

(1) Can or do cetaceans avoid spills?

(2) Acute and chronic impact of oil contact and/or ingestion on marine mammals

(3) Behavioral modifications of impacted cetaceans with respect to:

(a) Mother/pup interaction
(b) Selection of haul-out sites and rookeries
(c) Are there adverse thermoregulatory effects on neonatal seals?
(d) Demonstrations of physiologic or histologic changes in oil impacted marine mammals.

Without long-term control studies on the effects of oil on marine mammals, oil spills will provide the only source of data on such effects.

3. Performing Organizations:

College of the Atlantic, S. Katona-Census and behavioral Aspects

NEA, Prescott-All Aspects

URI, Winn/Dunn-Physiology, behavior, census, tagging

WHOI, Watkins-Tagging/census

NMFS, Woods Hole, John Nichols

ERCO, Boehm-Hydrocarbon analysis

Univ. of Maine, Gilbert-Census/tagging/behavior

4. Habitats Applicable:

   All but benthic. Because of mobility and species specific behavior, temporal requirements must be considered.

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

8. Cost:

9. Equipment Needs/Equipment Available:

10. Facility Needs/Facilities Available:

11. Personnel Needs/Personnel Available:

12. Support Services:

13. Payoff:

14. Limitations:

PANEL: BIRDS AND MARINE MAMMALS
PROJECT NO: 7
PRIORITY RANK:

1. Project Title: Summary of Birds and Marine Mammals for Offshore Oil Spills

2. Project Description:

Objectives: Attempt to determine species composition, relative abundance, distribution, and proportion of each species of bird and marine mammal that is visibly contaminated with oil in the area of the spill.

A. Birds

(1) Determine species composition, abundance, and distribution of birds in area of spill using a fixed-winged aircraft flown over a pre-selected grid, so as to randomly sample bird populations present on the contaminated and adjacent areas. Technique involves using 2 observers and 1 recorder in a fixed-winged twin engine hi-wing aircraft flown at 100 feet above sea level at 100 mph. All birds within a 300m transect will be counted by species for 10 minutes.

(2) Determine percent of each species that is visibly contaminated with oil, using 10-minute counts of the total number of each species within sight of the ship (Brown et al., 1975-Atlas of eastern Canadian seabirds, and MBO cruise reports--unpublished data). The ship must be moving at least 4 knots and on a fixed course.

(3) Determine by bird species the degrees (i.e., light, medium, or heavily oiled) of plumage oiling and areas of body affected (i.e., nape of neck, breast, belly, etc.)

B. Mammals

(1) Using a fixed-winged aircraft (probably that used for Coast Guard surveillance flights) marine mammal sightings will be made at 500-1000 feet to make species counts (techniques used in Tropical E. Pacific Tuna and Porpoise study of NMFS and California Bight Study by BLM).

(2) Sightings from surface vessels will be made to determine:

  (a) evidence of direct contact and coating of oil

  (b) interference with normal swimming or feeding behavior

  (c) obvious avoidance or attraction to spill area

3. Performing Organization:

A. Birds

(1) Manomet Bird Observatory
Kevin Powers
Brian Harrington
617/224-3559

(2) University of Rhode Island
Dr. Frank Heppner
401/792-2372

(3) College of the Atlantic
Dr. William Drury
207/288-5015

B. Marine Mammals

(1) College of the Atlantic
Dr. Steve Katona
207/288-5015

(2) New England Aquarium
John Prescott
617/742-8830

(3) University of Rhode Island
Dr. Howard Winn
401/792-6251

(4) Woods Hole Oceanographic Institution
William Watkins
617/548-1400

(5) National Marine Fisheries Service (Woods Hole)
John Nicholas
617/548-5123

4. Applicable Habitats:

Offshore only.

5. Applicable Conditions:

A. Aircraft - VFR marine mammals
Sea state $\leq$ 6 ft-birds
- additional base line data helpful (i.e., prior surveys or assessments of species composition and relative abundance in past years within the study area).
- Accessible air space, i.e., not restricted areas
- rapid response before spill, if possible.

B. Surface vessels

- platform availability (i.e., will appropriate vessels be available?)
- oil detectable from air or will be if uncontained

6. Applicable Oil Type:

All oils or groups of oils.

7. Time Frame:

A. Duration of spill, plus 2 weeks after spill is no longer detectable by aircraft.

B. Data analysis within 3 months.

8. Cost:

A. Aircraft-Marine mammals - may be USCG aircraft
Birds-$1000 per day (based on 10 hour day and 1 day needed to cover study area)
1 surveillance flight per week desired

B. Surface Vessels - range $500-$3000 per day
mean-$1750 per day
(10 days on study area per month desired)

C. Personnel

(1) Aircraft-marine mammals - 2 observers per flight
birds - 2 observers and 1 recorder per flight

(2) Surface vessels-marine mammals and bird observers should equal 2 people per ship.

(3) Exact cost of Manomet Bird Observatory observer=$100 per day (includes salary, ($12k/yr) and 57% overhead) - does not include travel expenses, food, per diem, etc.

D. Equipment (may sometimes be provided by certain institutions or agencies, but for this project proposal it is assumed that the NRT will provide necessary equipment).

(1) Photographic - $2000 per kit
1 kit includes: SLR 35-mm camera with motor drive and data back; 200-400mm zoom lens with gunstock attachment; 10 rolls @ 36-exp Tri-X film; 10 rolls p 36-exp Plus-X film)
(one kit needed per aircraft and surface vessel)

(2) Tape recorders-cassette @ $75

(3) Optics-1 pair 8x40 Swift W.A. binoculars or comparable item per observer.

(4) Expendables-$1000 for film processing

E. Automatic Data Processing of Bird Information

(1) Key punch and statistician's time grossly estimated at $1500

F. Phone, Xerox, etc. (if University-based study) costs grossly estimated at $500.

G. Principal Investigator

Salary range: $15,000-$25,000 per year, Mean: $20,000 per year

Consulting rates based on USFWS Scale = $\frac{\text{salary per annum}}{260}$ = $77.00 per day

Based on one month duration oil spill and three months' data analysis and report writing--4 months (20 working days per month) x $77.00 = $1,540 + P.I. at 25% of time for 3 additional months = $1,155.00.

Total Principal Investigator Cost: $2,695 per spill

9. Equipment Needs/Equipment Available:

As this project is largely observation oriented, little equipment will be required beyond optical and recording materials. One kit with the following materials will be required for each crew (aircraft or ship):

- single lens reflex camera back w/motor drive
- 200-400mm zoom lens w/gunstock attachment
- cassette tape recorder w/tapes
- 8 x 40 wide angle binoculars.

All these materials are potentially available through the appointed institutions, but are not guaranteed to be accessible at the moment of a spill. Kits should therefore be prepared in advance.

10. Facility Needs/Facilities Available:

Facility needs amount to aircraft and ship transport. The marine mammals aerial survey may dovetail with Coast Guard overflights and IR studies of the spill or operate on a timesharing basis with the bird surveys.

A. Aircraft- (1) highwing, $\overline{>}$ 2 engines, auxphilions preferred, VFR/IFR, deicing, communications, and navigational capability appropriate to pelagic survey, room for two observers, recorder, and pilot.

B. Surface Vessels - (3) ships of similar design or observational capability, range and construction suitable to open ocean work in poor sea conditions for 10 day minimum, hoists and nets for salvage and tagging capability, berths for at least two observers.

11. Personnel Needs/Personnel Available:

The principal investigator(s) and associates chosen from the list of performing organizations (See 3) will delegate staff for the project.

12. Support Services:

Relevant studies would include tagging programs, additional base line population research and any work pertaining to clarification of impacts on lower units of food chain supporting these top carnivores. These studies could be undertaken concurrently and/or outside the time frame of the spill.

13. Payoff:

This study provides the capability to clearly respond to public sentiment regarding impacts on wildlife. More specifically it addresses:

A. Short-term impact on wildlife at the spill site.

B. Behavioral alteration of a gross nature, i.e., avoidance of, or attraction to a slick, flight or swimming difficulties as a result of fouling.

C. Valuable supplement to the available population assessments--collect specimens under stress conditions.

14. Limitations:

A. Lack of base line data. The strongest recommendation made by this panel is for more hard data on the 'normal' populations in the U.S. Northeast Atlantic. This requires expensive and long-term studies.

B. These populations are highly mobile. Even with the best base line data in hand, a reduced population cannot be regarded as a certain response to stress.

C. Weather and sea state may severely disrupt the effectiveness of the project.

D. The extrapolation of observed species counts (or numbers of animals impacted) to population estimates may be inadvisable in some cases--especially with regard to population of great whales for which diving times and repeat sightings still constitute difficult statistical complications.

E. Initial counts of impacted birds may be extremely misleading. Oiled birds may die and sink before being counted or may retreat from the area following fouling or infection only to die outside the observation area (note Project No. 5, Birds and Marine Mammals).

Cost predictions for this project should be considered unreliable in light of the fact that most if not all of the equipment and facilities required can be "piggybacked" with other work by Coast Guard and research groups.

PANEL: BIRDS AND MARINE MAMMALS
PROJECT NO: 8
PRIORITY RANK:

1. Project Title: Assessment of Oil Spill Damage to New England Marine Turtle Populations

2. Project Description:

Two New England species of marine turtles are presently listed as endangered (Fed. Reg. 41 (208), p. 47195, 1976): the leatherback and the grey ridley. These species are migratory, and reach higher population densities in New England waters during summer and autumn than they do anywhere else within their known ranges (Lazell, 1976. This Broken Archipelago. Quadrangle. New York, and works cited therein).

Green, loggerhead, and hawksbill turtles, all listed as threatened or endangered, also occur in New England waters, the two former regularly and abundantly.

To date, baseline data are anecdotal, unsystematic, and scattered. We need a definitive pre-spill survey based on at least weekly overflights of Georges Bank, Cape Cod and Buzzards Bays, and Nantucket and Vineyard Sounds, from 1 June through 1 January.

Every marine turtle washed up dead along our coasts should be autopsied. It is believed that swallowing tar balls is a direct cause of death for at least leatherbacks. Because the various species feed on jellyfishes (especially *Cyanea* and *Aurelia*), they are apt to swallow blobs of petroleum (as well as other jellyfish mimics such as plastic bags and pot buoys). Direct toxicity to the turtles also must be expected whenever they surface within a spill.

3. Performing Organization:

Massachusetts Audubon Society, Lincoln, Mass. 01773 (Dr. J. D. Lazell, Jr., Staff Herpetologist).

4. Applicable Habitats:

All U.S. waters out 200 miles, north of Cape Hatteras, but especially Georges Bank, Cape Cod and Buzzards Bays, and Nantucket and Vineyard Sounds.

5. Applicable Conditions:

Marine turtles are active--both travelling and feeding--in waters above 7°C (about 45°F). Leatherbacks, being warm-blooded homeotherms, enter even colder waters. Certain types of spills, especially of crude oil, are dangerous even in weather and water too cold for the turtles, because the spilled material may sink, remain in the area, and rise again during warmer periods.

6. Applicable Oil Type:

All types must be considered potentially toxic to all marine turtles. Crude oil, however, because of its densities and blobbing characteristics, poses special threats in mimicking jellyfishes (see Lazell, op. cit., pp. 185-192, for descriptive and anatomical analysis of the problem).

7. Time Frame:

Pre-spill survey should begin ASAP, preferably 1 June 1978 and continue through 1 January 1979. Dead, stranded specimens should be autopsied, and preserved, for the foreseeable future. On the occasion of a spill between June and January, an immediate survey should be made.

8. Cost:

The major expenses are for travel. Estimated terrestrial travel would be about one thousand miles year. A weekly, one-day overflight is called for. A couple of shipboard days can be anticipated. A reward (say of $5.00) for live individuals inadvertently caught (e.g., in pound nets by commercial fishermen) should be offered, so that tagging and recapture may begin. Some chemicals will be expended in preservation and preparation of specimens found dead. A reasonable wage should be offered for student assistant(s).

Terrestrial travel at $0.15/mile	$ 150.00
Air travel at $100.00/day	2,800.00
Ship travel at $1000.00/day	2,000.00
Rewards and tagging	1,000.00
Chemicals	500.00
Assistant (one full time for 7 mos. at $3.00/hour)	5,360.00
TOTAL	$11,810.00

9. Equipment Needs/Equipment Available:

MAS can provide a half-ton, four-wheel drive truck with electric winch. This has been used regularly in the past to salvage and transport dead specimens. We have the necessary dissection and preparation equipment.

Airplane and ship will have to be arranged with other organizations and workers on a shared basis.

Tagging equipment can be obtained from Archie Carr or Nicholas Mrosovsky as soon as we can demonstrate the financial ability to follow through on its use.

MAS keeps some chemicals on hand, but this limited supply requires constant replenishment (pickling even a small marine turtle uses a lot of fluid).

10. Facility Needs/Facilities Available:

MAS has an adequate lab at the Endicott Sanctuary, Wenham, Mass., for autopsies, specimen and tissue preparation, and forzen storage.

The Museum of Comparative Zoology, Harvard University could serve as a repository for collected specimens.

Histologic preparations can be done at several area institutions, probably most reasonably dependent on the academic affiliation of of the student assistant.

Identification of petroleum products would have to be arranged with other workers on other oil spill assessment projects, presumably on a shared basis at a central facility (Marine Pathology Laboratory, URI, for example).

11. Personnel Needs/Personnel Available:

Lazell, MAS, is a full-time employee available on call for marine turtle work.

At least one student assistant will be needed on a basis equivalent to full-time for seven months (work will, in fact, tend to be less than 40 hours/week, but will surely spread out over the full year).

12. Support Services:

Lazell has been studying New England marine turtles, their abundance, distributions, ecologies, and anatomical specializations, for six years--whenever an opportunity arose (Lazell, *op. cit.*, pp. 120-192 and 244-246, and works cited therein). Dr. Robert Shoop, URI, Kingston, is also involved in local marine turtle studies. Lazell and Shoop can work well cooperatively.

The Cape Cod Museum of Natural History, Brewster, The New England Aquarium, Boston, and the National Marine Fisheries Service, Cloucester, all work cooperatively with us on salvaging and investigating marine turtles. However, no organization or institution in this area can presently underwrite the proposed study financially.

Lazell and Shoop are both in close contact with Carr, Mrosovsky, Pritchard, and the other marine turtle experts nationally and internationally.

13. Payoff:

Because of their status as endangered and threatened species, protected by Federal law, and because of their great seasonal concentrations in our waters, various marine turtles require ecological and biological understanding. This is especially true for leatherback and grey ridley; green and loggerhead are also likely to be severely impacted by human activities such as oil spills in New England waters.

Lazell is in the process of requesting a critical habitat designation for the leatherback that would include New England waters. It is imperative for marine turtle biologists, petroleum scientists and geologists, and other relevant personnel to work closely together for the benefit of these legally protected species if confrontation and tragedy are to be avoided.

14. Limitations:

Because marine turtles swim the Ocean of the Earth, our efforts in New England are only a part of a much larger whole. We cannot lose sight of that. Because the animals are concentrated here, close to scientists and institutions optimally suited to their study, our opportunities are tremendous and unique.

9. Equipment Needs/Equipment Available:

MAS can provide a half-ton, four-wheel drive truck with electric winch. This has been used regularly in the past to salvage and transport dead specimens. We have the necessary dissection and preparation equipment.

Airplane and ship will have to be arranged with other organizations and workers on a shared basis.

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CHEMICAL ANALYSIS AND FATE PANEL

Participants

W.D. MacLeod, Jr., Chairperson

W. Andrade
P. Boehm
R. Ceurvels
P. Gearing
R. Hiltabrand

E.J. Hoffman
G. Kleineberg
J. Lake
G. McLeod
P. Rogerson
T. Spittler

M. Wilson

CHEMICAL ANALYSIS AND FATE PANEL

General Considerations and Recommendations

- General Discussions
- Panel Results
- References

GENERAL DISCUSSIONS

A. Findings

The Panel made the following initial findings and recommendations:

1. The Panel accepted the current analytical chemical methodology as practiced throughout New England.

2. Sufficient laboratory capabilities are available throughout New England to meet the needs of any likely combination of oil spill damage assessments. ERCO (Cambridge, MA) appears to be in the best position to offer prompt large sample processing capacity (100's). EG&G (Waltham, MA) also appears well prepared to contribute expertise and analyses. Others such as EPA and URI (Narragansett, RI) and NOAA's National Analytical Facility (Seattle, WA) may be able to respond similarly depending on the circumstances, whereas the EPA (Lexington, MA) and New England Aquarium (Boston, MA) probably could handle only 10-20 samples. The Coast Guard Center (Groton, CT) may be too occupied with their own chemical analyses to participate except in an advisory role.

3. Initial chemical analytical surveying of the oil spill affected area should be done, if possible, by the Coast Guard's UV fluorescence method. The panel recommends that a mobile field analysis capability (lab-van, research vessel) be established and maintained in New England for rapid response to oil spills.

4. Preliminary sample analysis cost estimates:

    a) UV fluorescent screening: $50/sample

    b) Extraction, chromatography, gas chromatographic analysis, GC/MS backup: $350-500/sample.

5. The Panel recommends establishment of a committee of regional oil spill chemists who can be immediately consulted in the event of an oil spill. One committee member should represent these chemists on an interdisciplinary Technical Advisory Committee to the RRT/OSC. This chemist/representative should be accessible to the RRT/OSC to assist in immediate judgments on initial actions following an oil spill.

A significant point remained somewhat unresolved throughout our proceedings: the concept that during this workhop, realistic cost-effective, detailed chemical analysis projects could be devised collectively to assess ecological damages resulting from oil spills according to size, oil type, habitat, weather, season, climate, etc. [Only one panel member attempted to address this issue.] Instead, this panel has devoted its efforts to elaborating information on the capabilities of key analytical laboratories, the prompt availability of chemical consultants, the preferred analytical methodology, and some general advance preparations to be made, such as acquisition of field analysis and sampling equipment. Additional information and specifications can be introduced during review of the draft report. Successful synthesis of these materials into an overall program will be a most important factor.

B. Assignments

The following individual assignments were made to individual panel members for further development at the workshop:

1. Preliminary assessment of chemical analyses needed by other panels.

2. Special research opportunities afforded by oil spills.

3. Delineation of likely demands on chemical analyses with regard to:

    a) immediate emergency response to determine initial nature and extent of spill

    b) environmental damage assessment, intermediate and long term.

4. Elaboration of the role of a proposed "on-scene chemist," as part of an interdisciplinary Technical Advisory Committee available to the OSC.

5. Description of sample preservation and distribution procedures.

6. Design questionnaire to inventory chemical analysis and research capability applicable to New England oil spills.

7. Description of limitations of chemical analyses, i.e., what consequences could be expected of chemical analyses, what should not be expected; discuss some aspects of sampling strategy.

RESULTS

A. Chemical Analysis Needs of Other Panels

Table 1 gives the results of needed chemical analytical capabilities of other disciplines represented at the Hartford Workshop.

B. Identification of Existing Capabilities

An inventory of all organizations having equipment and personnel capable of petroleum hydrocarbon analyses has been made and oil spill research teams and ongoing oil spill research of these organizations will be identified. This survey was conducted by Dr. Mason P. Wilson of URI. The survey results are included in the Addendum to the Chemical Analysis and Fate Panel.

It is recommended that an advisory panel consisting of representatives from major oil spill research teams and organizations in Region I be formed. This team will help coordinate the scientific investigation of the spill and serve as an advisory panel at the request of the OSC. It is important to use Regional personnel whenever possible because of their expertise of the area. Compensations and per diem could be used as an incentive for continued participation of individuals not employed by the Federal government.

C. Recommended On-Scene and Advisory Support

1. Interdisciplinary On-Scene Committee

These are scientists who respond immediately to a spill. They are "on call" and respond when someone in authority activates the plan. As a minimum a chemist and a biologist might be called, but for a large spill more disciplines should be involved. These people are will advise the on-scene coordinator and coordinate and integrate any of

TABLE 1

ANALYTICAL CHEMISTRY NEEDED IN SUPPORT OF BIOLOGICAL AND PHYSICAL PROGRAMS

REQUESTED TASK (UV-FLUORESCENCE OR IR)	PANEL REQUESTING THIS ANALYSIS	ESTIMATED NUMBER OF ANALYSES[c]
Determination of areal extent of sediment contamination through screening (UV fluorescence) of sediments collected in potentially impacted areas	Benthic biology Lab toxicity Microbiology	200[a]
Determination of concentration of HC's in the water column as a function of depth location and time by screening (UV-fluorescence)	Water column Lab toxicity	2000[a] (50[b])
Determination of concentrations of HC's in tissue samples by screening (UV-fluorescence)	Water column	1000[a] (100[b])
UV fluorescence or I.R. monitoring of HC levels in tanks used in lab toxicity experiments (UV-fluorescence or IR)	Lab toxicity	50[a]/tank (est a = 5 tanks)

[a] Chemist estimate.

[b] Biologist estimate.

[c] This obviously depends highly upon habitat, size of spill, etc.

TABLE 1 (Continued)

REQUESTED TASK (GC AND MS)	PANEL REQUESTING THIS ANALYSIS	ESTIMATED NUMBER OF ANALYSES
Changes of oil chemistry as a function of time in the sediment	Microbiology Benthic biology	50
Vertical distribution of oil in the sediments - chemical variations with depth	Benthic biology	50
HC composition (quant. & qual.) in tissues of selected key organisms	Benthic biology	20
	Lab toxicity	20
	Histopathology	20
	Water column	100 (20)
	Marine mammals	20
Polynuclear aromatics in water column esp. if spill in subtidal area	Benthic biology	5-10
HC composition of oil in gut contents and on feathers of oiled birds	Marine mammals and birds	400 (20)
HC levels in bird tissues	Marine mammals and birds	20
GC monitoring of HC composition in lab toxicity experiments	Lab toxicity	5 /tank (est = 5 tanks)
HC levels in tissues of lab experiment organisms	Lab toxicity	100
HC compositional changes as a function of time in sea slicks	Microbiology	20
HC compositional changes as a function of time in benthic infauna	Microbiology	50

TABLE 1 (Continued)

REQUESTED TASK (GC AND MS)	PANEL REQUESTING THIS ANALYSIS	ESTIMATED NUMBER OF ANALYSES
Cargo oil complete analysis	All	5
Dissolved and particulate HC's in seawater	Benthic Biology	40
HC content in sediments and water of cages as a function of time	Benthic Biology	20 /cage
HC content as a function of size of plankton	Water column	15
HC content of fish flesh	Water column	30
Compositional changes of slick - water column during use of dispersants	Physical group	20
Quality assurance analyses 10% of total	All	60
Blanks 10% of total		60

TABLE 1 (Continued)

REQUESTED TASK (NON-HYDROCARBON ANALYSES)	PANEL REQUESTING THIS ANALYSIS	ESTIMATED NUMBER OF ANALYSES
Dissolved O_2, $S^0/00$ nutrients	Water column	50 each
Mixed function oxidases	Bird and mammal	20
Blood chemistry parameters	Bird and mammal	20
Analysis of sediment for OC, N, P	Microbiology Benthic biolo	20
Analysis of lipids in tissues of selected organisms	Benthic biology	20
Eh of sediments	Microbiology	20
Biochemical assays lipids, carbohydrates, proteins, RNA, LPS, exoenzymes, metabolites	Microbiology	20 /parameter
Analysis of phytoplankton for C, N, ATP, chlorophyll, biomass, POC	Water column	20 /parameter

REQUESTED TASK (PHYSICAL PARAMETERS)	PANEL REQUESTING THIS ANALYSIS	ESTIMATED NUMBER OF ANALYSES
Cargo oil	Physical group	
pour point		2
density as function of weathering		10
surface tensions		20
composition of emulsion forming oils versus non-emulsion forming oils		5

TABLE 1A

TOTALS OF REQUIRED ANALYSES IF THE ENTIRE REGIONAL RESPONSE PLAN HEREIN DESCRIBED WERE IMPLEMENTED.*

Analysis type	Chemist estimate	Biologist estimate**
HC analysis:		
UV-fluorescence	350	3200
Infra-red	250	250
GLC	775	1255
GLC-M.S. (10% of GLC)	75	125
Non Hydrocarbon:		
Routine oceanographic parameters - water	250	250
Sediment analyses - nutrients, etc.	80	80
Biochemical assays	260	260
Plankton parameters	120	120
Physical measurements	37	37
Trace metal analyses	100	100
TOTAL	2297	5677

*Chemistry panel projects 2 and 3 overlap with biology projects. Project 1 requires air analyses (20 GLC). Project 4 requires 80-100 bioenzyme assays of fish. Project 5 requires ~100 trace metal analyses. These values have been added in to the biology-physical analytical requests to arrive at a complete estimate of analytical support required.

**The chemist estimate is used when the biologists did not specify.

the specific scientific studies that become activated. There should be a mobile laboratory (the old EPA trailer?) stocked with sampling gear, containers and the other items necessary for the field support effort. It should also be equipped with enough instrumentation (e.g., UV-fluorescence and/or IR) so that samples could be analyzed in the field. This will give the On-Scene Coordinator and the biologists the knowledge of where the oil is and where it is not.

2. Advisory Groups

In support of each discipline activated in the on-scene committee, there should be a regional group of experts on whom the committee members could call on for help and advice. For example, the hydrocarbon chemists in New England would organize into a committee which would meet periodically. They would be available to the responding chemist to help him with whatever problems come up. This same mechanism can be set up for the biologists, physical process people, and whomever else it would be appropriate for. This gives a mechanism whereby almost everyone in the area working with oil pollution could be called onto a spill site, if needed.

D. Sampling Considerations

The sample strategy to be utilized for sampling oil-impacted environments is adequately covered in "An Oil Spill Sampling Strategy" by Woollcott Smith (WHOI). While that note outlined the best procedure to be utilized in an oil-spill event, several comments on its content arose in our panel discussions. The group appears to be in general agreement with Smith's conclusions that a grid pattern of sampling covering the entire area is best, that ancillary information should be obtained, and that the size of the grid survey should be determined by the cost and manpower available rather than by the cost of analyzing the samples. However, several considerations were not addressed by Smith and he raises several interesting questions which seem best handled by pragmatic decisions by an on-scene chemist:

1. If numerous samples are taken, how will they be transported and where will they be stored to avoid decomposition and/or degradation?

2. Smith's last paragraph speaks to the inability of oil-spill surveys to assign a direct or indirect causal relationship between the oil spill and differences observed in the survey. He then states that "One must turn to scientific results from controlled experiments on the effects of oil to show the probable relationship between the impact of oil on the survey area and the

results of the survey analysis." It seems, then, that without the necessary back-up of data from controlled laboratory tests on effects of oil on organisms (which do not presently exist), oil-spill surveys have very limited value.

3. Experience in oil-spill situations has shown that oil often distributes in a patchy manner; large differences in the concentration of oil are seen on both the large scale and the small scale. It seems that in order to survey the extent and concentration ranges of an oil spill-impacted environment, tremendous numbers of samples (a far finer grid sampling pattern) must be taken, stored, and analyzed.

4. Smith states that "the control area should include sediment and water depths similar to the affected area." Oil spills may be extensive and it may be difficult to find suitable control areas within many miles (e.g., Chesapeake Bay Spill). Do the control areas then, contain similar sediment and environmental characteristics as the impacted areas?

These are four points that emphasize the need to preserve the freedom of action of the on-scene chemist to direct the field sampling operation. Unfortunately, this may mean that a statistically valid program is not possible. However, it is apparent that legal action must commence without the necessary back-up of a direct or indirect causal relationship between the oil spill and differences observed in the survey. Therefore, our best and most practical effort (as directed by the on-scene chemist) to survey oil-impacted areas must suffice.

E. Sample Preparation and Chain Custody

Sediment, biological, and water samples collected at a spill site should be distributed by a central regional laboratory and the transfer of these samples should be accompanied by a chain of custody record similar to the one recommended by the Coast Guard.

Preparations should be made in advance to store sampling equipment where it can readily be available during an emergency. All samples collected should be preserved or extracted immediately upon collection. Mobile facilities should be available for this.

REFERENCES

The following reports were submitted with the panel report or otherwise identified:

1. Research by NOAA National Analytical Facility, Environmental Conservation Division, Northwest and Alaska Fisheries Center.

2. A Pilot Study on the Design of a Petroleum Hydrocarbon Baseline Investigation for Northern Riget Sound and Strait of Juan de Fuca. W.D. MacLeod, D.W. Brown, R.G. Jenkins, L.S. Ramos and V.D. Henry. NOAA Technical Memorandum ERL MESA-8. November 1977.

3. Energy Resources Company, Inc. Oil Spill Response Capabilities. ERCO, Cambridge, MA.

4. Bowdoin College Hydrocarbon Contamination Research Center.

5. Techniques and Proposals/USGS Contributions to Overall Ecological Damage Assessment. Compiled by F.T. Manheim. August 1977.

6. U.S. Coast Guard: The U.S. Coast Guard Oil Spill Identification System (1977) is now available from NTIS (CG-D-52-77). Documents may also be available on "Sampling, Sample Handling and Chain of Custody Procedures" as soon as published. Manuals on "Field Thin-Layer Chromatography Method for Oil Identification" and "Field UV Fluorescence Spectroscopy Method for Oil Identification" can be made available, from: U.S. Coast Guard R&D Center, Groton, CT.

CHEMICAL ANALYSIS AND FATE PANEL

Recommended Projects

1. The physical-chemical weathering of oil at sea.
2. The physical-chemical weathering of beached or stranded oil.
3. The chemical fate of biologically assimilated oil.
4. The monitoring of the aryl hydrocarbon hydroxylase enzyme system in sessile teleost fish and selected benthic infauna.
5. Feasibility of using trace metal ratios to identify oil and/or tarball sources after weathering.

PANEL: CHEMICAL ANALYSIS AND FATE
PROJECT NO: 1
PRIORITY RANK: NOT ASSIGNED

1. Project Title: The Physical and Chemical Weathering of Oil at Sea

2. Project Description:

This project will study the changes in hydrocarbon and non-hydrocarbon (NSO compounds*) composition of (1) the spilled oil, (2) of the adjacent water, and (3) of the air mass.

We do not know how spilled oils partition and are altered immediately following a spill. Weathering studies have never addressed the combined questions relating to hydrocarbon as well as metabolite (i.e., phthalates, fatty acids, phenols) chemistry. The bacterial metabolites and photo-oxidation products are more soluble and potentially more toxic than are the hydrocarbon compounds.

The study will be carried out by continually sampling a given patch of oil, monitoring the water below and air above the patch, thereby establishing a realistic mass balance.

This information, in addition to being fundamental to our chemical understanding of oil spills, is essential for toxicological investigations and links to microbiological degradation studies and physical processes.

3. Performing Organizations:

Woods Hole
URI
ERCO
EG&G

Probably these groups will have to interact closely to provide seagoing oceanographers and sampling capability. ERCO seems well equipped to handle large sample numbers. However, URI probably has more experience in air sampling (C. Brown, J. Quinn).

4. Applicable Habitats:

Pelagic, salt pond, estuarine

---

*Non-hydrocarbon (nitrogen, sulfur and oxygen containing) compounds are also referred to as NSO compounds.

5. Applicable Conditions:

A. All spilled oil conditions.

B. Weather conditions must permit accurate sampling as far as depth under oil slick.

6. Applicable Oil Type:

All, although fuel oils and light crudes are more apt to result in good data sets due to more rapid dissolution and evaporation rates.

7. Time Frame:

Start immediately and continue as long as oil mass can be traced; probably on the order of a week to several weeks. Sample every hour, perhaps.

8. Cost:

Analytical ≅ \$25,000

Ship Time ≅ \$15,000 (time shared with other groups)

Total Cost ≅ \$50,000 (open ocean)

≅ \$30,000 (near shore)

9. Equipment Needs/Equipment Available:

A. Sampling bottles (Bodman, Niskin)

B. Air sampling gear

C. On-board sample extraction capability

D. Sample containers

E. GC and GC/MS; IR capability

10. Facility Needs/Facilities Available:

A. Ship or small boat

B. Analytical lab

11. Personnel Needs/Personnel Available:

A. Presently available to ERCO, URI, WHOI

B. Immediate response needed

ERCO can respond immediately, others later

12. Support Services:

Physical process group must interact.

13. Payoff:

Our knowledge of chemical alterations of spilled oil is meager. This knowledge is fundamental to any ecological assessment.

14. Limitations:

A. Good sampling weather is needed.

B. Good analytical schemes in identifying especially non-hydrocarbon secondary products is essential.

PANEL: CHEMICAL ANALYSIS AND FATE
PROJECT NO: 2
PRIORITY RANK: NONE ASSIGNED

1. Project Title: The Physical-Chemical Weathering of Beached or Stranded Oil

2. Project Description:

An immediate and long-term study following the chemical changes in stranded oil and the chemical recovery of a given environment.

It is carried out by sampling polluted shoreline substrate as well as tarry residues from beached oil. Also, short cores should be taken.

This includes hydrocarbon as well as NSO compounds.

Ref: Blumer: The Environmental Fate of Stranded Crude Oil (Deep Sea Research?)

3. Performing Organizations:

ERCO
WHOI
URI
Bowdoin
EPA/Narragansett
NOAA NAF
EG&G

4. Applicable Habitats:

Applies to any habitat where oil has reached the bottom or shoreline, excludes pelagic habitats.

5. Applicable Conditions:

All conditions applicable although offshore bottom would pose problems in rough weather.

6. Applicable Oil Type:

Any oil type applicable.

7. Time Frame:

Start immediately. Sample daily for 2 weeks; then weekly for 6 months; then monthly for 5 years.

8. Cost:

≅ 100 samples x \$500 = \$50,000

onshore sampling = \$ 5,000

offshore sampling = \$50,000

Total = \$55,000 - \$100,000

9. Equipment Needs/Equipment Available:

- GC, GC/MS
- Grab sampler on hand-held beach corers
- Available soon after spill; however, immediate analyses not needed
- Jars needed

10. Facility Needs/Facilities Available:

A. Onshore: sampling and analytical equipment and instrumentation

B. Offshore: small or large boat depending on distance offshore

C. Facilities are available on short notice

11. Personnel Needs/Personnel Available:

Personnel are available on short notice from universities, from private contractors (ERCO) and NOAA-NAF.

12. Support Services:

Must interface with microbiology program and benthic biologists.

13. Payoff:

A. Short and long-term weathering of stranded oil, from both the hydrocarbon and non-hydrocarbon perspective, is sorely needed using glass capillary GC.

B. Can relate chemical changes directly to changes in microbial and faunal populations.

14. Limitations:

Must carefully select sampling areas and preserve them from disturbance (i.e., cleanup operations).

Offshore station revisitation may be tricky and sediment resuspension and physical disruption of study may occur.

PANEL: CHEMICAL ANALYSIS AND FATE
PROJECT NO: 3
PRIORITY RANK: NOT ASSIGNED

1. Project Title: The Chemical Fate of Biologically Assimilated Oil

2. Project Description:

This project is designed to trace the chemical changes that occur in biologically assimilated oil over a long period of time. Clean organisms, shellfish (Mytilus or Mercenaria), are kept in a controlled area (lab or field) and are completely characterized chemically. After a spill, and as oil approaches land, these organisms are either marked or are put in cages and deployed near shore before the oil landfall.

The initial chemical uptake of oil is monitored by sampling this deployed population; subsequent samples reveal further uptake, degradation or depuration for the months following the landfall of oil. Individual tissues should be monitored chemically and histopathologically throughout the study.

Ref: D. Salvo et al: Environmental Science and Technology (1975?)

3. Performing Organizations:

A. Biological Deployment

MBL
Taxon
URI
EG&G

B. Chemical Analysis

ERCO and/or NOAA NAF
URI
EG&G

4. Applicable Habitats:

Oyster-Mussel Reef
Rocky Shore
Salt Marsh
Salt Pond
Clam Flat

5. Applicable Conditions:

A. All conditions applicable. In fact, this experiment is designed for massive dosing (direct) or indirect contamination via the water column.

B. Need controlled, chemically-characterized organisms.

6. Applicable Oil Types:

All types of oil could be studied.

7. Time Frame:

Starts immediately before landfall and can continue for several years. Should sample immediately and continue weekly for 2 months, then monthly for 5 years.

8. Cost:

A. Modest total cost = $50,000 - $75,000

B. Analyses, deployment and maintenance of test animals

Analyses = $50,000

Maintenance deployment = $10,000

Test animal maintenance = $10,000

9., 10., and 11. Equipment, Facility, Personnel Needs/Availability:

A. Need facility for storing animals prior to deployment; flow-through tanks, etc. (New England Aquarium; URI). Personnel for deployment (URI); perhaps small boat for deployment (URI).

B. Analytical equipment (GC, GC/MS) and large facility (ERCO, URI, Bowdoin).

12. Support Services:

Must interface with histopathologists. Individual tissue analyses essential.

13. Payoff:

This is a very critical type of study. Chemical impacts and histopathological studies for the first time can be interfaced and cause-and-effect relationships established under careful monitoring of these deployed animals. Behavioral and biochemical responses of adjacent communities then can be more fully understood.

14. Limitations:

Animals may not react naturally in cages; therefore, marking organisms and deploying them in a marked area may be necessary.

PANEL: CHEMICAL ANALYSIS AND FATE
PROJECT NO: 4
PRIORITY RANK: NOT ASSIGNED

1. Project Title: The Monitoring of the Aryl Hydrocarbon Hydroxylase (AHH) Enzyme System in Sessile Teleost Fish and Selected Benthic Infauna (e.g., Nephtys)

2. Project Description:

The AHH system has been studied recently by Gruger et al (Bull. of Environ. Cont. and Toxicol.) and Payne (Science, 1977). AHH activity is induced by exposure to polynuclear aromatic hydrocarbons (PNA's). Assaying for AHH can be of great importance in assessing subtle impacts of spilled oil and may precede more important and obvious effects.

3. Performing Organizations:

A. Chemical Analysis: Environmental Conservation Division, NMFS/Seattle

B. Sampling: NMFS/Woods Hole

4. Applicable Habitats:

All habitats where appropriate species are available.

5. Applicable Conditions:

All conditions; this may be a good indication of spilled oil dispersion and the extent of impact of a certain spill event.

6. Applicable Oil Type:

Better for large quantities of aromatic hydrocarbons (e.g., fuel oil, Venezuelan crude), but can apply to all spill events.

7. Time Frame:

Days to several weeks; the exact time frame is unkown. Research has not yet indicated the response lag of the enzyme system to PNA stress.

8. Cost:

$25,000 - $30,000 (80-100 assays at $300 apiece)

9. and 10. Equipment, Facility Needs/Availability:

A. Needs:

Trawling and dredging for fish and invertebrates.

Ship for trawl/dredge operations.

Analytical facilities - enzyme assay system.

B. Facilities that may assist:

NOAA/Seattle - E. Gruger

ERCO - P. Boehm

EPA/Narragansett - G. Jackem

11. Personnel Needs/Personnel Availability:

Shipboard for sampling and lab technician. Required personnel should be readily available.

12. Support:

Should correlate with chemical analyses of PNA and histopathology.

13. Payoff:

May be the pollution monitoring mechanism that we need to spot early biochemical changes in marine systems exposed to oil (PNA).

14. Limitations:

Enzyme may be activated by PCB's and other aromatic compounds as well. More lab research is needed to complement field studies.

PANEL: CHEMICAL ANALYSIS AND FATE
PROJECT NO: 5
PRIORITY RANK: NOT ASSIGNED

1. Project Title: Feasibility of Using Trace Metal Ratios to Identify Oil and/or Tarball Sources after Weathering

2. Project Description:

This project will study changes in trace metal ratios in petroleum products (especially crude, #6) as a function of time in the environment, and examine applicability of such measurements to fingerprint oils even after substantial weathering.

Very little is known about what happens to trace metals (i.e., Ni, V, Mo, Fe) in petroleum when the hydrocarbons begin to weather and/or degrade. Although there is interest in conducting weathering experiments with various crude oils, it will be necessary to verify these results under actual environmental conditions. Sampling of the oil should proceed as described in Project 1 so that the samples for organic and inorganic analyses can be collected simultaneously. Thus hydrocarbon weathering data can be directly compared to the progress of inorganic weathering.

3. Performing Organizations:

Places where the capability presently exists, all have neutron activation and atomic absorption expertise.

EPA-Narragansett
ERCO
WHOI
URI

4. Applicable Habitats:

All habitats.

5. Applicable Conditions:

Routine monitoring of the surface oil and oil in the sediments on a long-term basis will be necessary.

6. Applicable Oil Type:

Crude oils and heavy fractions (i.e., #6).

7. Time Frame:

Start immediately and continue as long as oil mass can be traced.

8. Cost:

Analytical - $5,000
Ship time (shared with other groups) - $15,000
Total cost - $10,000 nearshore
$30,000 off-shore

9. Equipment Needs:

a. Sample containers
b. Slick collection device
c. Grab samplers
d. Analytical instrumentation (neutron activation, atomic absorption, etc.).

10. Facilities Needed:

a. Ship/small boat
b. Analytical facilities

11. Personnel needs:

Presently available to EPA-Narragansett, URI, WHOI, ERCO.

12. Support Services:

Physical process group must interact, tracking of oil necessary.

13. Payoff:

a. Knowledge of chemical alterations of spilled oil is meager. Influence of trace metals-hydrocarbon synergistic effects is unknown as well.

b. Possibility of identifying the oil source long after it has been in the environment makes the study attractive from an enforcement/legal point of view.

14. Limitations:

See Project No. 1 from this Panel.

ADDENDUM TO
CHEMICAL ANALYSIS AND FATE PANEL

TABLE 1

OIL SPILL RESEARCH AND LABORATORY QUESTIONNAIRE

Name and Address:	Alternate person to be contacted, and
Dr. William J. Andrade	address: Elio Goffi
U.S. EPA ~~60 Westview Street~~	60 Westview Street
Lexington, MA 02173	Lexington, MA 02173
Bus. Phone: (617) 861-6700 ext 277	Bus. Phone: (617) 861-6700 ext 277
Home Phone: (617) 275-1809	Home Phone: (617) 444-5316

Sponsoring Agencies: U.S. EPA Division Surviellance and Analysis

ANALYTICAL EQUIPMENT: If more than one, insert number.

Infra-red ( ) Make Recicman IR-20A

Gas Chromatography:

packed column 2 glass capillary ______ Mass spec 1

UV Fluourscence:

Type ______________

Microbalance __________

GENERAL DESCRIPTION OF EXTRACTION TECHNIQUES: Aqueous 15% methylene chloride/hexane; 2) Sediment soxhlet extraction toluene/methanol; 3) Tissue methanol extraction.

TYPES OF SAMPLES ANALYZED: Sediment yes Tissue yes Seawater yes

Tarballs ______ Cargo yes Other ______________

OTHER LAB CAPABILITIES: Ecosystem tanks, weathering, etc.

FIELD WORK CAPABILITIES: Sediment, water column, surface, doplet size and distribution, etc., please list filed equipment.

RESPONSE CAPABILITY:

(1) How many people can you muster in 24 hours?

(a) to obtain samples _______

(b) to analyze samples 4

(2) Do you need sponsoring agency approval?

Yes X No ____ Recommended ____

(3) Are you part of an oil spill research team? Yes ____ No X

(4) If so, what is the expertise of the team and individual members? Please list: ______

(5) Can the whole team response? Yes ___ No ___ Not applicable ___

(6) Are there other people or laboratories in your organization that can respond? Yes ___ No ___. If yes please list names and addresses. ______

(7) Under what conditions can you respond? (or cannot respond)
All we need is directive from superiors.

(8) What is your primary interest? Oil spill research ____ Impact assessment ____ Other, please explain No specific interest but to help where possible. Most of our experience has been in oil spill identification.

OIL SPILL RESEARCH AND LABORATORY QUESTIONNAIRE

Name and Address:	Alternate person to be contacted; and
Dr. Paul Boehm	address: William Steinhauer
ERCO, 185 Alewife Brook Pkwy	ERCO, 185 Alewife Brook Pkwy.
Cambridge, MA 02138	Cambridge, MA 02138
Bus. Phone: ( ) 617-661-3111	Bus. Phone: ( ) 617-661-3111
Home Phone: ( ) 617-369-7791	Home Phone: ( ) 617-354-0104

Sponsoring Agencies: BLM, EPA

ANALYTICAL EQUIPMENT: If more than one, insert number.

Infra-red (1) Make Perkin Elmer 283

Gas Chromatography:

packed column 1 glass capillary 5 Mass spec 1 (GC/MS)
(HP 5840) (HP System)

UV Fluourscence:

Type Farrand Mk-1

Microbalance Cahn 4100

GENERAL DESCRIPTION OF EXTRACTION TECHNIQUES: Standard Farrington, Quinn and BLM methodologies.

TYPES OF SAMPLES ANALYZED: Sediment yes Tissue yes Seawater yes (90 liter capacity)

Tarballs yes Cargo yes Other surface film/air samples

OTHER LAB CAPABILITIES: Ecosystem tanks, weathering, etc.

FIELD WORK CAPABILITIES: Sediment, water column, surface, droplet size and distribution, etc., please list filed equipment. (Experience in all phases of oceanographic sampling equipment, see attached list.)

RESPONSE CAPABILITY:

(1) How many people can you muster in 24 hours?

(a) to obtain samples 4

(b) to analyze samples 4

(2) Do you need sponsoring agency approval? yes ____ no ____ recommended ___

*yes for use of BLM field equipment
*no for analytical and personnel requirements

(3) Are you part of an oil spill research team? yes ____ no __X__

(4) If so, what is the expertise of the team and individual members?

Please list: ______________________________

____

____

(5) Can the whole team respond? yes ____ no ____ not applicable __X__

(6) Are there other people or laboratories in your organization that can respond? yes __X__ no ____. If yes please list names and addresses. Dr. Tom Novitsky - Marine Microbiology

Dr. Steve Piotrowicz - Trace Metal Chemistry

____

(7) Under what conditions can you respond? (or cannot respond)

Can respond under most conditions; our group is at sea 4 times per year, so spills during our field activities may pose problems of timing.

(8) What is your primary interest? Oil spill research __X__ Impact assessment __X__ Other, please explain Methodology improvement and development

Please return to:

Dr. Mason P. Wilson, Jr.
Department of Mechanical Engineering
and Applied Mechanics
Wales Hall Room 101
University of Rhode Island
Kingston, Rhode Island 02881

OIL SPILL RESEARCH AND LABORATORY QUESTIONNAIRE

Name and Address:	Alternate person to be contacted, and
Dr. Chris W. Brown	address: Mark Ahmadjian
Department of Chemistry	Department of Chemistry
University of Rhode Island	University of Rhode Island
Bus. Phone: (401) 792-2369	Bus. Phone: (401) 792-2369
Home Phone: (401) 294-2029	Home Phone: ( )

Sponsoring Agencies: ERDA, API and RI Coastal Resources Management Council

ANALYTICAL EQUIPMENT: If more than one, insert number.

Infra-red ( ) Make Beckman 4260, Perkin Elmer 521

Gas Chromatography:

packed column X glass capillary X Mass spec X

UV Fluourscence:

Type ________

Microbalance ________

GENERAL DESCRIPTION OF EXTRACTION TECHNIQUES:

TYPES OF SAMPLES ANALYZED: Sediment X Tissue X Seawater X

Tarballs X Cargo X Other Air

OTHER LAB CAPABILITIES: Ecosystem tanks, weathering, etc.

FIELD WORK CAPABILITIES: Sediment, water column, surface, doplet size and distribution, etc., please list filed equipment.

RESPONSE CAPABILITY:

(1) How many people can you muster in 24 hours?

(a) to obtain samples 6

(b) to analyze samples 6

(2) Do you need sponsoring agency approval?

Yes ____ No ____ Recommended X

(3) Are you part of an oil spill research team? Yes _X_ No ____

(4) If so, what is the expertise of the team and individual members?
Please list: Chemistry, microbiology, wind/wave effects,
transport, dropsize

(5) Can the whole team response? Yes _X_ No ___ Not applicable ___

(6) Are there other people or laboratories in your organization that can respond? Yes _X_ No ___. If yes please list names and addresses. ____________________

(7) Under what conditions can you respond? (or cannot respond)

Any

(8) What is your primary interest? Oil spill research _X_ Impact assessment ____ Other, please explain ____________________

OIL SPILL RESEARCH AND LABORATORY QUESTIONNAIRE

Name and Address:	**Alternate person to be contacted; and address:** John Der Hovanesian
A. Russell Ceurvels	
Cat Cove Marine Laboratory 92 Fort Avenue Salem, MA 01970	Cat Cove Marine Laboratory 92 Fort Avenue Salem, MA 01970
Bus. Phone: (617) 745-3107	**Bus. Phone:** (617) 745-3107
Home Phone: (617) 526-1906	**Home Phone:** (617) 483-6515

Sponsoring Agencies: ______

ANALYTICAL EQUIPMENT: If more than one, insert number.

Infra-red (X) Make B & L 250

Gas Chromatography:

packed column X glass capillary ______ Mass spec ______

UV Fluourscence:

Type P & E MPF-3

Microbalance ______

GENERAL DESCRIPTION OF EXTRACTION TECHNIQUES: Varies-Farrington method

TYPES OF SAMPLES ANALYZED: Sediment X Tissue X Seawater X

Tarballs ______ Cargo X Other ______

OTHER LAB CAPABILITIES: Ecosystem tanks, weathering, etc.

FIELD WORK CAPABILITIES: Sediment, water column, surface, droplet size and distribution, etc., please list filed equipment.

RESPONSE CAPABILITY:

(1) How many people can you muster in 24 hours?

(a) to obtain samples 4

(b) to analyze samples 3

(2) Do you need sponsoring agency approval? yes ______ no X recommended X

Not for immediate emergency

(3) Are you part of an oil spill research team? yes ____ no __X__

(4) If so, what is the expertise of the team and individual members?

Please list: ____

____

____

(5) Can the whole team respond? yes ____ no ____ not applicable ____

(6) Are there other people or laboratories in your organization that can respond? yes ____ no ____. If yes please list names and addresses. ____

____

____

(7) Under what conditions can you respond? (or cannot respond)

(8) What is your primary interest? Oil spill research __X__ Impact assessment __X__ Other, please explain ____________________

____

Please return to:

Dr. Mason P. Wilson, Jr.
Department of Mechanical Engineering
and Applied Mechanics
Wales Hall Room 101
University of Rhode Island
Kingston, Rhode Island 02881

OIL SPILL RESEARCH AND LABORATORY QUESTIONNAIRE

Name and Address:
Dr. John W. Farrington
Associate Scientist
Chemistry Department
Woods Hole Oceanographic Inst.
Woods Hole, Mass. 02543
Bus. Phone: (617) 548-1400 ext 316
Home Phone: (617) 540-2878

Alternate person to be contacted, and address: Mr. Bruce W. Tripp
Research Associate
Chemistry Department
Woods Hole Oceanographic Inst.
Woods Hole, Mass. 02543
Bus. Phone: (617) 548-1400 ext 353
Home Phone: (617) 548-6999

Sponsoring Agencies: EPA, CNR, NSF, ERDA

ANALYTICAL EQUIPMENT: If more than one, insert number.

Infra-red ( ) Make Perkin Elmer 337

Gas Chromatography: (6) Various models of Varian and Hewlett Packard, Carlo ERDA

packed column * glass capillary * Mass spec *

UV Fluourscence:

Type Perkin Elmer MPF-3

Microbalance 2 Cahn Balances

GENERAL DESCRIPTION OF EXTRACTION TECHNIQUES:

TYPES OF SAMPLES ANALYZED: Sediment * Tissue * Seawater *

Tarballs ______ Cargo ______ Other ______

OTHER LAB CAPABILITIES: Ecosystem tanks, weathering, etc. Available on long lead time notice, e.g., environmental systems lab.

FIELD WORK CAPABILITIES: Sediment, water column, surface, doplet size and distribution, etc., please list filed equipment. Sediment, water column sampling with grabs, box cores, large volume water samples, portable laboratory.

RESPONSE CAPABILITY:

(1) How many people can you muster in 24 hours? 3
  (a) to obtain samples 3
  (b) to analyze samples 3

(2) Do you need sponsoring agency approval?
  Yes * No ____ Recommended ____
  Or approval to expend institution funds, as in case of Argo Merchant.

(3) Are you part of an oil spill research team? Yes ____ No ____
Depends on definition.

(4) If so, what is the expertise of the team and individual members? Please list: See above

(5) Can the whole team response? Yes ___ No ___ Not applicable •

(6) Are there other people or laboratories in your organization that can respond? Yes ___ No ___. If yes please list names and addresses. I cannot speak for other laboratories.

(7) Under what conditions can you respond? (or cannot respond)

Difficult to predict. We have several on-going projects which require our time and effort. On several occasions our gear may be at sea.

(8) What is your primary interest? Oil spill research ____ Impact assessment ____ Other, please explain Organic geochemistry research in the marine environment especially the sediment water interface. This includes research on organic pollutants.

OIL SPILL RESEARCH AND LABORATORY QUESTIONNAIRE

Name and Address:
Dr. Patrick Gearing
Dr. Juanita Gearing
Marine Ecosystems Research Lab
~~URI - GSO~~
Kingston, RI 02881

Bus. Phone: (401) 792-6140 or 6133

Home Phone: (401) 423-2045

Alternate person to be contacted, and address: ____

Bus. Phone: ( ) ____

Home Phone: ( ) ____

Sponsoring Agencies: EPA

ANALYTICAL EQUIPMENT: If more than one, insert number.

Infra-red ( ) Make P.E. 267

Gas Chromatography:

packed column PE3920B glass capillary ____ Mass spec ____

UV Fluourscence:

Type ____

Microbalance Cahn 4100

GENERAL DESCRIPTION OF EXTRACTION TECHNIQUES: Saponification - extraction by reflux; soxhlet; homogenizer - depending on sample type.

TYPES OF SAMPLES ANALYZED: Sediment X Tissue X Seawater X

Tarballs X Cargo ____ Other ____

OTHER LAB CAPABILITIES: Ecosystem tanks*, weathering, etc.
*but not applicable directly to future spills

FIELD WORK CAPABILITIES: Sediment, water column, surface, doplet size and distribution, etc., please list filed equipment.

RESPONSE CAPABILITY:

(1) How many people can you muster in 24 hours?

(a) to obtain samples 0

(b) to analyze samples 0-3, depending on circumstances

(2) Do you need sponsoring agency approval?

Yes X No ____ Recommended ____
(if only after-the-fact)

(3) Are you part of an oil spill research team? Yes X No ___

(4) If so, what is the expertise of the team and individual members? Please list: see attachment

(5) Can the whole team response? Yes ___ No X Not applicable ___

(6) Are there other people or laboratories in your organization that can respond? Yes ___ No X . If yes please list names and addresses. ___

(7) Under what conditions can you respond? (or cannot respond)

Short-term studies of spills of geochemical interest.

(8) What is your primary interest? Oil spill research ___ Impact assessment ___ Other, please explain ___

organic geochemistry

Principal Investigators, Marine Ecosystems Research Laboratory (MERL)

Dr. John W. Farrington
Woods Hole Oceanographic Institution

Biogeochemistry of petroleum compounds, fuel oils and crude oils in experimental ecosystems

Dr. Richard F. Lee
Skidaway Institute of Oceanography

Fate of petroleum components in a coastal marine ecosystem

Dr. James G. Quinn
Graduate School of Oceanography, URI

Distribution and fate of petroleum hydrocarbons in coastal marine ecosystems

Dr. Wallace S. Broecker
Lamont-Doherty Geological Observatory

Experiments with radioactive tracers in the facility for the experimental analysis of coastal marine ecosystems

Dr. David L. Johnson
State University of New York, College of Environmental Science and Forestry

Environmental perturbation and chemical speciation

Dr. Michael E. Q. Pilson
Graduate School of Oceanography, URI

Cycling of certain trace constituents: sediment gradients and exchange with the water column

Dr. Donald R. Heinle, Dr. Sandra L. Vargo
University of Maryland, Center for Environmental and Estuarine Studies

Effects of petroleum hydrocarbons on the physiology, feeding behavior and population dynamics of copepods

Dr. Scott W. Nixon, Dr. Candace A. Oviatt
Graduate School of Oceanography, URI

Effects of petroleum and other energy-related stresses on the rates and mechanisms of nutrient regeneration by coastal marine bottom communities

Principal Investigators, (MERL) (continued)

Dr. Candace A. Oviatt
Graduate School of Oceanography, URI

Multivariate analysis of hydrocarbon stressed microcosms

Dr. Akella N. Sastry
Graduate School of Oceanography, URI

Physiological responses of benthic organisms in experimental ecosystems and the effects of petroleum hydrocarbon stress

Dr. Theodroe J. Smavda
Graduate School of Oceanography, URI

Responses of marine phytoplankton to petroleum hydrocarbon stresses

Dr. J. Frederick Grassle, Dr. Judith P. Grassle
Woods Hole Oceanographic Institution and the Marine Biological Laboratory

Benthic community structure in experimental ecosystems and the effects of petroleum hydrocarbons

Dr. John Sieburth, Dr. Paul Hargraves
Graduate School of Oceanography, URI

Bacterial and protozoan components

OIL SPILL RESEARCH AND LABORATORY QUESTIONNAIRE

Name and Address:
E. S. Gilfillan
Bowdoin College Marine Res. Lab.
Brunswick, ME 04011
Bus. Phone: (207) 725-8731 ext 604
Home Phone: (207) 633-2590

Alternate person to be contacted, and address: D. S. Page
Chemistry Department
Bowdoin College
Bus. Phone: (207) 725-8731 ext 602
Home Phone: (207) 729-4264

Sponsoring Agencies: NSF, State of Maine DEP

ANALYTICAL EQUIPMENT: If more than one, insert number.

Infra-red ( ) Make Perkin Elmer 621

Gas Chromatography: Perkin Elmer 900 2 w/solid samplers
990 1 w/pyrolysis probe

packed column _____ glass capillary 3920B Mass spec _____

UV Fluourscence:

Type Perkin Elmer M204

Microbalance Perkin Elmer AD-2

GENERAL DESCRIPTION OF EXTRACTION TECHNIQUES: Sediments-pentane/benzene extraction 48 hrs. Tissues-MeOH/KOH 2 hrs-pentane extraction of result column chromatography - G.C.

TYPES OF SAMPLES ANALYZED: Sediment X Tissue X Seawater X

Tarballs X Cargo X Other _____

OTHER LAB CAPABILITIES: Ecosystem tanks, weathering, etc.

FIELD WORK CAPABILITIES: Sediment, water column, surface, doplet size and distribution, etc., please list filed equipment. Tissue samples

RESPONSE CAPABILITY:

(1) How many people can you muster in 24 hours?
(a) to obtain samples 4-6
(b) to analyze samples 2-4

(2) Do you need sponsoring agency approval?
Yes ____ No ____ Recommended X

(3) Are you part of an oil spill research team? Yes X No ___

(4) If so, what is the expertise of the team and individual members? Please list: E. S. Gilfillan - Environmental Physiologist, D. S. Page - Hydrocarbon Chemist, R. P. Gerber - Zooplankton Physiologist.

(5) Can the whole team response? Yes X No ___ Not applicable ___

(6) Are there other people or laboratories in your organization that can respond? Yes ___ No X. If yes please list names and addresses.

(7) Under what conditions can you respond? (or cannot respond)
On most instances we can respond, however, there may be some instances where we cannot respond.

(8) What is your primary interest? Oil spill research X Impact assessment ___ Other, please explain

OIL SPILL RESEARCH AND LABORATORY QUESTIONNAIRE

Name and Address:
James Lake
ERL-N, South Ferry Road
Narragansett, RI
Bus. Phone: (401) 789-1071
Home Phone: (401) 783-5046

Alternate person to be contacted, and address: Pete Roberson
same
Bus. Phone: ( )
Home Phone: ( )

Sponsoring Agencies: EPA

ANALYTICAL EQUIPMENT: If more than one, insert number.

Infra-red ( ) Make 621 Perkin Elmer

Gas Chromatography:

packed column yes glass capillary 2 Mass spec 1

UV Fluourscence:

Type --

Microbalance --

GENERAL DESCRIPTION OF EXTRACTION TECHNIQUES:

TYPES OF SAMPLES ANALYZED: Sediment X Tissue X Seawater X
Tarballs ____ Cargo X Other ____

OTHER LAB CAPABILITIES: Ecosystem tanks, weathering, etc.

FIELD WORK CAPABILITIES: Sediment, water column, surface, doplet size and distribution, etc., please list filed equipment.

RESPONSE CAPABILITY:

(1) How many people can you muster in 24 hours?
(a) to obtain samples 1-2 ?
(b) to analyze samples 2

(2) Do you need sponsoring agency approval?
Yes ____ No ____ Recommended ____

Need Lab. management approval.

(3) Are you part of an oil spill research team? Yes ____ No _X_

(4) If so, what is the expertise of the team and individual members? Please list: ______________________________

____

____

(5) Can the whole team response? Yes ___ No ___ Not applicable _X_

(6) Are there other people or laboratories in your organization that can respond? Yes ___ No ___. If yes please list names and addresses. ___?___________________________

____

____

(7) Under what conditions can you respond? (or cannot respond)

(8) What is your primary interest? Oil spill research _X_ Impact assessment ____ Other, please explain ______________________

____

OIL SPILL RESEARCH AND LABORATORY QUESTIONNAIRE

Name and Address:
Dr. William D. MacLeod
NOAA National Analytical Facility
2725 Montlake Blvd., East
Seattle, WA 98112

Alternate person to be contacted, and address: Donald W. Brown
same

Bus. Phone: (206) 442-4240
Home Phone: ( ) ________

Bus. Phone: ( ) same
Home Phone: ( ) ________

Sponsoring Agencies: NOAA/National Marine Fisheries Service; also EPA, BLM, etc.

ANALYTICAL EQUIPMENT: If more than one, insert number.

Infra-red (1) Make ________

Gas Chromatography:

packed column 1 glass capillary 3 Mass spec 2

UV Fluourscence: 1

Type dual offset scan, fully corrected

Microbalance 2

GENERAL DESCRIPTION OF EXTRACTION TECHNIQUES:
See Appendix A of NOAA Technical Memorandum ERL MESA-8 forwarded separately

TYPES OF SAMPLES ANALYZED: Sediment X Tissue X Seawater X

Tarballs X Cargo X Other ________

OTHER LAB CAPABILITIES: Ecosystem tanks, weathering, etc.
High performance liquid chromatography: 2 instruments, one automated UV fluorescence HPLC detector

FIELD WORK CAPABILITIES: Sediment, water column, surface, doplet size and distribution, etc., please list filed equipment.
Can place 1-2 experienced field chemists at the oiled site within a few days

RESPONSE CAPABILITY:

(1) How many people can you muster in 24 hours?

(a) to obtain samples Possibly 1-2 England NMFS chemists or biologists

(b) to analyze samples 4 chemists

(2) Do you need sponsoring agency approval?

Yes X* No ____ Recommended ____

*Also require authorized funds

(3) Are you part of an oil spill research team? Yes __X__ No _____

(4) If so, what is the expertise of the team and individual members? Please list: State of the Art analyses of marine environmental samples for trace contamination by oil. Employ glass capillary GC, GC/MS, HPLC and UV.

(5) Can the whole team respond? Yes _____ No __X__ Not Applicable _____

(6) Are there other people or laboratories in your organization that can respond? Yes __X__ No _____. If yes please list names and addresses.

Robert C. Clark
Chemical Oceanographer
NMFS/Seattle

(7) Under what conditions can you respond? (or cannot respond)
We can and will respond to all U.S. jurisdictional major oil spills, unless the NOAA NAF staff is fully committed to other projects.

(8) What is your primary interest? Oil spill research _____ Impact assessment _____ Other, please explain _____

PHYSICAL PROCESSES PANEL

Participants

J.A. Galt, Chairperson

R. Beauchamp
P. Cornillon
W. Grant
C. Griscom
Capt. K.M. Palfrey
C.E. Parker
A. Pollack
J. Ripp
M. Spaulding
R. Wright

PHYSICAL PROCESSES PANEL

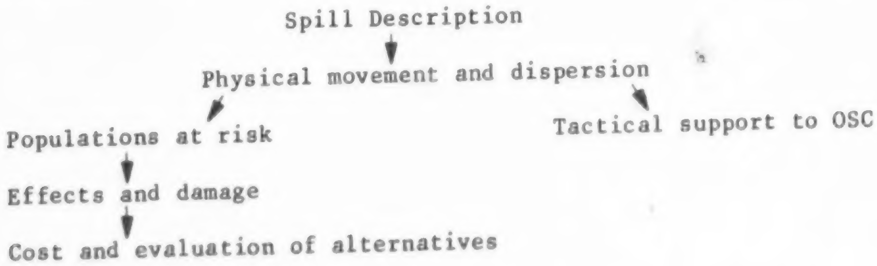
General Information

- Background Considerations
- Specific Subject Areas

BACKGROUND CONSIDERATIONS

A. Role of Physical Processes Research

Initial discussion centered on the role of physical processes studies in the general assessment problem and for the tactical support of the on-scene-coordinator. It was agreed that physical processes studies should be thought of as supportive and carried out as a sequence, passing on distribution data to aid in cleanup, operational planning, and selection of sites for detailed biological study.


Spill Description
Physical movement and dispersion
Populations at risk
Tactical support to OSC
Effects and damage
Cost and evaluation of alternatives

B. Products of Physical Processes Research

Information needed as products from the physical processes studies will be descriptions of the oil distribution in time and space including: 1) form the oil is in, 2) composition of the oil, and 3) concentrations. These data will establish appropriate areas to study impact as well as control sites. They should also result in environmental forecasts and estimates of the effects on distribution of possible cleanup actions (burning, emulsification, etc.). A question was raised with regard to physical forecasts for models of biological distributions (mixed layer depth and compensation depths for example?)

C. Pertinent Physical Processes

Dominant physical processes were discussed in terms of four general areas:

1. Advection
   - geostrophic flow
   - Ekman flow
   - wind drift/wave drift
   - tides
   - shelf waves/eddies
   - longshore drift
   - sediment transport by waves
   - estuarine flow
   - river flow

2. Mixing
   - spreading
   - mixed layer dynamics
     - wave compression
     - Langmuir cells
     - turbulence
   - waves
   - chemical dispersion

3. Sources and Sinks
   - spill definition
   - evaporation
   - sinking
   - incorporation with sediments
   - oxidation
     - burning
     - photo
     - biological
   - cleanup
   - ice
   - biological transport

4. Oil Associated With Sediment
   - residence times and transport descriptions
   - sediment fluxes and oil particle interactions
   - bioturbation
   - biodegradation

It was agreed that these processes largely covered the subject and that for any particular area and source, a fraction of these may be dominant. Basically these represent the framework in which the projects can be developed.

D. Initial Project Areas

An initial list of projects to be considered was as follows:

(1) Meteorological observations
(2) Mapping of oil spills
(3) Trajectory forecasting/hindcasting
(4) Thickness, distribution and form forecasting
(5) Vertical distribution and accommodation description
(6) Particle and oil interactions
(7) Biological interactions
(8) Lagrangian measurements
(9) Current meter mooring experiments
(10) Bottom boundary layer studies
(11) Characterization of oil in sediment resident times

SPECIFIC SUBJECT AREAS

A. Catalogue of Embayments and Development of Current Algorithms

Particular publications have been completed, or are near completion, which address a catalogue of embayments. The following publications specifically address the Atlantic Outer Continental Shelf and the associated near-shore areas. Funds for these literature summaries have been provided by BLM.

Update of the Institute of the Gulf of Maine's (TRIGOM) report on environmental information from the U.S./Canadian Border to Cape Hatteras, N.C. The study is being conducted by the Center for Natural Areas (CNA) presently located in Washington, D.C. Principal contact for this study is Mr. Ned Shenton. Expected completion date is October 1977. Approximately 50 copies of the report will be available at the BLM New York OCS Office at the World Trade Center, New York City. BLM contact is Dr. Arthur Horowitz (212/264-2401).

The Institute of the Gulf of Maine (TRIGOM) completed a Socio-economic and Environmental study from the U.S./Canadian Border to Sandy Hook, New Jersey, in June 1974. This 8 volume report is also available at the BLM New York OCS Office. BLM contact is the same as above.

B. Development of Regional Reference Document

In addition to the studies described above, the following BLM sponsored study programs will also have input to the development of a regional reference document:

- U.S. Geological Survey ongoing program dealing with chatterer sediment mobility and suspended sediment flux on the Georges Bank region. This program also includes water column hydrography (surface, subsurface and bottom current studies). Report is expected to be completed in April 1978. Principal contact is Dr. David Folger of USGS, Woods Hole, Massachusetts (FTS-837-4155).

- Raytheon Company of Portsmouth, Rhode Island, and EG&G of Waltham, Massachusetts, are conducting a physical oceanography program for BLM on Georges Bank.

  Specific inputs to this physical oceanography study will include Lagrangien measurements, Eulerian measurements (surface and subsurface current meter moorings) and support hydrography. Principal objective is trajectory forecasting.

  A report of the first year program will be available in August 1978. An additional 2 years of data collection and interpretation is planned. Specific contact is Dr. Richard Scarlett of EG&G and Dr. David Cook of Raytheon Co. BLM contact is Mr. Ken Berger of the New York OSC Office.

- At the present time, BLM and EDS/NOAA are discussing advantages of having a historical summerization and interpretation of meteorological and physical oceanographic information for the Georges Bank region. A study could begin by December 1977, and expected time of completion would be April 1979. BLM contact on progress of this possible study is Mr. Ken Berger - New York OCS Office.

C. Additional Needs

The following additional needs for ecological damage assessment were identified:

1. An inventory to include:
   - selected bibliography
   - names, addresses, phone numbers
   - facilises (including charter)
   - equipment, large and small, including sources of rental items (like ENDECO current meters)

2. Simple, unambiguous, clear and complete instructions for field observers and collectors, to include "chain of custody" requirements as well as sampling techniques.

3. Reliable, accessible, informed Public Information Officer to get accurate information out as fast as possible and to reduce the pressure on those doing the work.

4. Provision of SOR Team training to selected local individuals or groups and of SOR Team equipment kits on hand - especially hard to get materials and equipment.

5. Arrangements with NSF to free academic types for oil spill work (no-cost extension, etc.).

6. Quick way to put people on Federal payroll for short-term emergency.

7. Assurance that costs incurred by non-Federal organization will be promptly reimbursed.

8. Compilation of existing information on what happens when oil hits the shoreline.

9. Appropriate descriptors for oil, i.e., what should be the basic independent variables used as environmental descriptors for oil or, more generally, hydrocarbons?

D. Equipment Requirements

The following equipment was recommended for stockpiling by the OSC or otherwise immediately available:

1. Satellite tracked drogues

2. 1000 bottom drifters and 1000 surface drift cards, appropriately labeled and ready for deployment (total cost $5K)

3. Minirangers for accurate navigation

4. Chart library

5. Typewriters, Xeroxes, CB radios

PHYSICAL PROCESSES PANEL

Recommended Projects*

1. Meteorological observations and analysis
2. Surface mapping
3. Trajectory forecasting/hindcasting
5. Bottom boundary layer and sediment (oil) residence time
7. Longshore and rip current dynamics
8. Coastal current studies

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*Projects 4 and 6 were not submitted at the time of this report.

PANEL: PHYSICAL PROCESSES
PROJECT: 1
PRIORITY RANK: 1

1. Project Title: Meteorological Observations and Analysis

2. Project Description:

   A. Objective - To provide accurate observations and useful forecasts of wind speed and direction, sea state, precipitation, visibility and other weather conditions that could affect cleanup efforts or that could be entered into trajectory predictions.

   B. Method - Establishment of an on-scene meteorological office with equipment and personnel dedicated to the job of producing local forecasts at least four times daily based on all available data.

   C. Results - Basic data for tactical decisions by on-scene coordinator; basic data for trajectory models and predictions of areas likely to be affected by oil or suitable for controls; and data base for after the fact verification of models and development of new hypotheses.

3. Performing Organization:

   Principally National Weather Service, with help from ships on the scene and satellite observations. Also EG&G, through Dr. Wm. Bendel has this capability.

4. Applicable Habitats:

   All.

5. Applicable Conditions:

   All.

6. Applicable Oil Type:

   All.

7. Time Frame:

   As long as the on-scene coordinator is responsible for the spill -- probably several days to a few weeks.

8. Cost:

$20-$30K

(Equipment approximately $15 to $20K for weatherfare, radio, teletype, etc.)

(Personnel approximately $10-$15K for three meteorologists, wages and living expenses for up to 3 weeks).

9. Equipment Needs:

Van or office with desk, weatherfare, radio, teletype, telephone, and typewriter. NWS should be responsible for having portable equipment available.

10. Facility Needs:

No special needs other than described in item (9) for small near-shore spill. For larger offshore spills, ships on the scene can provide information and a weather data buoy may be useful. Satellite observations should be obtained routinely, as well as small-scale weather phenomenon and local weather from existing weather radar facilities.

11. Personnel Needs:

We understand NSW is training a group of marine meteorologists. Arrangements should be made to make two or three of these available as needed. Alternatively, Joseph Chase of Falmouth, a retired WHOI Meteorologist/Oceanographer, could be retained as consultant.

12. Support Services:

Good communication for rapid reporting of data and dissemination of forecasts.

13. Payoff:

A. Principally, the On-Scene Coordinator (OSC) decides where, how and when to deploy his resources.

B. Provide input for trajectory modelers, both for direct use by OSC and to identify sites of probable impact and potential control areas where experiments should be conducted.

C. Improve ability to forecast distribution of oil if substantial quantities become airborne as a result of evaporation or either accidental or deliberate burning.

D. Provide data for after-the-fact studies of oil weathering, interaction with biological communities, mixing in water column, etc.

14. Limitations:

New England weather is difficult to predict. Wind speed error of 5 knots and direction error of 30° are considered excellent (Argo report). Shortage of offshore data will be a problem for some spills.

PANEL: PHYSICAL PROCESSES
PROJECT: 2
PRIORITY RANK: 1

1. Project Title: Surface Mapping

2. Project Description:

The objective of this project is to provide accurate surface maps at meaningful time intervals to show the progress and extent of an oil spill to the Regional Response Team and the On-Scene Coordinator (OSC).

The time interval between maps will be primarily dictated by the strength of the tide in the area. Near-shore and energetic areas require one map each 3 hours; while in off-shore areas of low current speed, one each day is sufficient.

Observations less than about 5 miles from shore will be taken from locally leased light aircraft and boats. Farther off-shore, longer ranged (usually Federally operated) aircraft capable of safer overwater operation with a heavier payload should be used. Both types of aircraft should be capable of accurate navigation (mini-rangers for light aircraft). Photographic and deice recording of observations supplemented by sea surface temperatures (infrared thermometer) are needed to show the presence of thermal fronts, eddies, shoals and major currents that may affect the oil movement. Local flight weather conditions are also noted.

All data gathered for the time period should be incorporated in schematic form on a single chart accompanied by a brief description of the results given to the OSC within 1 to 3 hours after the flight.

In addition to the observational aspects of this program, a research component is needed. This facet of the program will be directed at developing remote sensing techniques that can accurately detect and map oil on the ocean surface under all weather conditions. This remote mapping capability is a long range and continuing need for operational and assessment aspects of spills.

Reference: The Argo Report and SOR Team

3. Performing Organizations:

SOR Teams
ERDA
Coast Guard and non-government labs such as Woods Hole Oceanographic Institution
EG&G
University of Rhode Island
Chesapeake Bay Institute
NASA

4. Applicable Habitats:

All.

5. Applicable Conditions:

Mapping efforts are weather limited, but conditions and procedures for safe operation of aircraft are well documented. Conditions not covered are those encountered when making aerial observations of oil in ice fields, fog and snow. These areas need special research to develop new techniques. The important fact is that marine disasters often occur under these conditions.

6. Applicable Oil Type:

All except gasoline whose half-life is usually too short to mount an aerial program for more than a day.

7. Time Frame:

Mapping should continue until the oil either goes ashore and stays there or moves out to sea and is either operationally difficult to follow or is lost.

8. Cost:

AC time, 2 weeks, 3 to 4 hours/day	$20,000
6 people, time, expenses, travel,	28,000
Equipment, 2 satellite buoys	10,000
Navigator	10,000
Support services (photo, etc.)	5,000
Communications	2,000
	$75,000

R&D contracts for remote sensing techniques	$75,000

9. Equipment Needs:

    1) Mini-rangers for light aircraft navigation
    2) Infra-red radiation thermometers
    3) Cameras--two for each aircraft film: color and infra-red light meters
    4) Binoculars
    5) Smoke bombs or other wind indicators
    6) At least one satellite tracked buoy/spill
    7) Charts and drafting equipment
    8) Telefax - Xerox machine
    9) Radio

    Stock pile items with Marine Safety Officer at Coast Guard bases.

10. Facility Needs:

    a. Coastal near-shore with a small spill requires < 20 ft. boats, small aircraft or 4-wheel drive vehicles for beach work. Radio type communication, small building or shop with drafting space and telecommunication available.

    b. Off-shore large spills require the use of major dockside facilities for large ships and equipment.

11. Personnel Needs:

    It is suggested that a SOR type of educational program be started. A cadre of regional people would familiarize trainees with the methods, procedures and local experts in order to enhance rapid response capability.

12. Support Services:

    Access to: photolab with quick turn around, drafting equipment, teleprinter or telefax machine, Xerox, typewriters, and a stock pile of charts of the area.

13. Payoff:

Information to OSC
Information to sampling teams
Information to assessment of damage (legal)

14. Limitations:

a. Surface mapping from aircraft is nonqualitative

b. Coordination with other disciplines is poor.

c. Adverse weather severely limits effectiveness.

d. Data gathered is not precise enough to advance modeling techniques for forecasts.

e. Coast Guard in-house capabilities should be improved to provide an operational system to be used with others.

PANEL: PHYSICAL PROCESSES
PROJECT: 3
PRIORITY RANK: HIGH

1. Project Title: Trajectory Forecasting/Hindcasting

2. Project Description:

Trajectory models to describe the distribution of spilled hydrocarbons will be developed and exercised. This will include time and space dependent estimates of where the oil is, where it will go and in some cases where it has come from. It will be necessary to provide information products that describe the form of the oil (pancakes, windrows, etc.) and its distribution throughout the water column. This project will have both observational facets supported by field studies and theoretical components.

Oil movement forecasting techniques have been developed to the point where the general movement of a surface slick can be predicted, if adequate supporting environmental background data is available. Unfortunately, little more than the center of mass of the slick can now be provided reliably using state-of-the-art methods. Key questions that still cannot be answered, and which must be supported with additional research, relate to what form the oil is in, i.e., patch spreading, thickness distribution and extent of mixing within the water column. It is clear from a study of the assessment problem that virtually all the environmental interactions with oil (biological uptake, flocculation, photo-oxidation, etc.) and most cleanup activity will be more dependent on the surface area and form of the oil than its actual mass. Such forecasts and predictors then must be developed and made available during oil spill incidents for support of cleanup and assessment activities.

3. Performing Organizations:

Major responsibility for forecasting should go to NOAA (NWS-Dr. Celso Barrientos-ERL Dr. J. A. Galt) with research support from academic institutions, USGS and states, and Ocean Engineering Dept. - University of Rhode Island, Dr. Malcolm Spaulding - URI, Dr. Richard Scarlet - EG&G.

4. Applicable Habitat:

All.

5. Applicable Conditions:

Any time the oil is spilled into an active circulation system. In the absence of supporting environmental data that already has supplied sufficient information to develop the needed trajectory algorithms, the studies should be initiated.

6. Applicable Oil Type:

All types of oils with a sufficient observation base are established to permit reliable forecasting.

7. Time Frame:

These observational studies and tactical support of OSC should be continued while oil forecasts are needed in cleanup activity.

8. Cost:

On-scene support (per spill)

Small spill $10km^2$	1 man-month $4K
Medium spill $50km^2$	2 man-months $8K
Big spill $100km^2$	6 man-months $24K

Computer development $3 to $6K
and support per spill

Research/analysis of spill data (not dependent on number of spills)

Computer software development	$30K
Algorithm research	$50K per year for 3 years Depends on scope

9. Equipment Needs:

a. Phone lines

b. Telefax

c. Computer terminals

d. Access to computing facilities

e. Drafting equipment

10. Facility Needs:

On-scene room, typically a motel room, could be a van or camper with communication hook-up.

11. Personnel Needs:

Trained oil trajectory forecasters on-scene (NWS-Marine Services Program -- NSW-Tech. Dev. Lab. Dr. Celso Barrientos; ERl-PMEL Dr. Jerry Galt). Also, Ocean Engineering - URI, Dr. Malcolm Spaulding, Dr. Peter Cornillan.

12. Support Services:

Mapping of oil.

SOR Team measurements of differential oil/water movement.

Detailed weather forecasts.

Local circulation data for currents.

13. Payoff:

Forecasts and hindcasts of oil movement and concentrations will be the payoffs of this project.

14. Limitations:

To work, this project will need appropriate background environmental data (currents, weather, etc.) plus an access to observational data as would be obtained from a mapping and SOR team type project.

To fully support assessment studies additional research will have to be carried out to develop algorithms to describe oil thickness distributions and large scale spreading.

PANEL: PHYSICAL PROCESSES
PROJECT: 5
PRIORITY RANK:

1. Project Title: Bottom Boundary Layer and Sediment (Oil) Residence Time

2. Project Description:

Sediment residence time provides information on:

a. Duration of oil impact, e.g., oil impregnation of bottom sediment, which is a multiplier for damage evaluation.

b. Direction and dynamics of movement of oil and sediments along bottom. This subject should be identified as a future research project.

The investigation incorporates detailed mapping of shallow structure, e.g., by high-resolution seismic, backed by sediment coring, coupled with bottom instrument packages capable of continuous measuring of dynamic properties, includes both wave and current measurements, temperature, turbidity and pressure (interpretation of bottom shear should be achievable from presently available models). The studies should yield maps of sediment (potential oil) residence time, plus a realistic assessment of conditions affecting transport of oil or treatment materials.

3. Performing Organizations:

a. USGS Atlantic-Gulf of Mexico Branch. Office of Marine Geology* offers immediate response on completion of new coastal workboat (anticipated Spring 1978), or partial assistance prior to that time. Assistance includes bottom instrument emplacement. See draft proposal submitted to workshop. Background (pre-spill) study highly recommended.

b. WHOI Ocean Engineering - W. D. Grant

c. MIT - Prof. Ole S. Madsen - Civil Engineering

d. U. Conn. Prof. Frank Bohlen

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*Woods Hole Mass: D. Folger 837-4155.

e. Corps of Engineers has extensive basic data (cores, seismic profiles).

f. URI - Dr. Mason Wilson

g. NOAA sediment dynamics group (expertise in N.Y. Bight area).*

h. Partial data in Massachusetts Bay available as a result of preliminary experiments in NOMES program. ERL-BOULDER.

i. Partial data in Block Island-Rhode Island Sound from bottom mounted E/M meter for spoil disposal and power plant cooling system surveys. URI-DMR-Griscom.

j. Bottom turbulence monitoring system - USN-UWS-Shontig.

k. EG&G - Dr. Richard Scarlet.

4. Applicable Habitats:

Off-shore bottoms.

5. Applicable Conditions:

Can (should) be determined as baseline study in High Risk, Marine Traffic Corridors before spill; pinpointing afterward. (See p. 16-17; Fig. 2 in USGS proposal for key profiles).

6. Applicable Oil Type:

Any oil type.

7. Time Frame:

Key coastal areas should be systematically mapped and reinvestigated at multiple yearly intervals until a comprehensive inventory is obtained. Each investigation of a given interval requires about 1 month field survey time. Bottom instrument packages may be retained longer in given spill site if necessary. Sample workshop requires additional 1 month workup time for each field survey (preliminary study). Some data available to OSC immediately on return of field gear.

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*D. J. Swift, NOAA-AOML-Miami.

8. Cost:

Per one month, area investigation for field deployment, including personnel; not including data workup: $30K.

One bottom instrument package can be supplied at present for emergency use without personnel or equipment changes.

Bare Boat with operator - $177/day.

Additional cost for transport, truck rental, three support personnel, expendables as indicated in "Yellow boat project" report obtainable from R. Would, USGS Woods Hole, 02536.

9. Equipment Needs:

Coring equipment, high resolution seismic equipment, bottom instrument package (e.g., USGS "TRIPODS" for long-term deployment. Location equipment.

10. Facility Needs:

Coastal work boat, truck rental, normal temporary coastal accommodations, computer facilities for seismic data manipulation and interpretation.

11. Personnel Needs/Personnel Available:

URI - C.A. Griscom, F. Middleton, V. Narci

USGS - Yes: immediate response

USN - D. Shontig, Newport, R.I.

After Spring 1978

Present - bottom instrument only

See R. Wold or D. Folger 837-4155, FTS, USGS Woods Hole

Item No. 3 C-F availability subject to change.

12. Support Services:

Background (sequential) on bottom sediment.

Configuration and Dynamic Properties, highly desirable.

13. Payoff:

Map of Bottom Dynamic conditions of immediate use to OSC; useful to predict oil impact duration and "multiplier effect" on damage assessment (residence time). Aids estimate of time involved in bottom movement, discrimination of highest priority areas in event of limited cleanup or deterrence capacity. Prediction of particle erosion of bottoms and presence in water column.

14. Limitations:

A. The project is most useful in in-shore areas having high risk potential and where sedimentation-erosion patterns show reasonable continuity. The effect of extreme events such as storms and hurricanes is not well predicted by bottom instrument packages emplaced under normal conditions; this area is partly covered by acoustic surveying-coring. Also predictive models for sediment transport and bottom shear stress on the continental shelf still are in the developmental stages. All three elements, geophysical profiling, coring and dynamic measurement, are needed for maximum effectiveness. Even though areas of potential sediment transport are identified, our present knowledge is not adequate to give quantitative numbers except under very specialized conditions.

B. Availability of personnel.

PANEL: PHYSICAL PROCESSES
PROJECT: 7
PRIORITY RANK:

1. Project Title: Longshore and Rip Current Dynamics

2. Project Description:

   A. Objectives:

      (1) Prediction of magnitudes and directions of longshore currents and rip currents.

      (2) Identification of research needs for the development of adequate models of longshore currents and rip current models.

   B. Procedure:

      (1) Information to modelers and on-site coordinators provided by:

         (a) Empirical current and wave measurements - current meters, wave sensors, sediment size

         (b) Regional reference document

         (c) Simple analytical models.

   C. Anticipated Results

      (1) Longshore currents in the surf zone and immediate vicinity.

      (2) Description of rip currents and coastal cells.

3. Performing Organization:

   A. Organization with Capability

      (1) Massachusetts Institute of Technology - Dr. Ole S. Madsen, Civil Engineering

      (2) Woods Hole Oceanographic Institution - Dr. William D. Grant, Ocean Engineering

      (3) University of Massachusetts - Dr. Allen Niedoroda

(4) University of Rhode Island - Dr. Malcolm Spaulding, Dr. Peter Cornillon, ocean engineering modeling; Dr. C.A. Griscom, Dr. R. McMaster, GSO, measurement; Dr. J. Fisher, Dr. J. Boothroyd, Geology, measurement

(5) Boston College - Dr. Benno Brenninkmeyer

(6) EG&G - Dr. Richard Scarlet

B. Possible Performing Organizations

All of the above - possibly in cooperative project

4. Available Habitat:

New England - surf zone

5. Applicable Conditions:

Spill heading toward coastline

6. Applicable Oil Type:

All.

7. Time Frame:

a. Predictions needed over tidal cycles to get directions.

b. Empirical measurements will provide immediate results.

c. Longer term research is needed into Longshore current models -- possibly provided by National Sediment Transport Study.

8. Cost:

$30K (for observational program in the event of a spill - does not include research costs).

9. Equipment Needs/Equipment Available:

a. Current meters capable of resolving both wave and current flows.

(1) E/M current meters

(2) Acoustic current meters

    (3) Wave measuring devices

    (4) Sediment sampling.

b. Woods Hole Oceanographic Institution

MIT

University of Massachusetts

University of Rhode Island

10. Facility Needs/Facilities Available:

a. Small boats available
Computer for our current models
Four-wheel drive vehicles

b. Woods Hole Oceanographic Institution
MIT
University of Massachusetts
University of Rhode Island

11. Personnel Needs/Personnel Available:

a. See item 3a.

b. Volunteers to make beach observations.

12. Support Services:

a. Mapping of spill

b. Meteorological data

c. Beach observations - beach slope, wave direction, tides, winds, breaker type, water depth, wave height, and wave period.

13. Payoff:

a. Contribution to assessment of Ecological Impact:

    (1) Trajectory of oil down coast to try to determine where to center cleanup.

    (2) Support service to determine ultimate fate of spill.

(3) Major consideration is that once oil is inside surf zone it is too late to prevent spill damage on shore. Thus, it is necessary to make the current predictions a significant period of time ahead.

b. Scientific Interest:

(1) Forcing function contributing to longshore current (currently under study).

(2) Longshore current distribution.

14. Limitations:

a. Availability of equipment/personnel

b. Weather conditions

c. Present model of wind devices, longshore currents, etc.

PANFL: PHYSICAL PROCESSES
PROJECT: 8
PRIORITY RANK:

1. Project Title: Coastal Current Studies

2. Project Description:

   A. Objectives:

      (1) Prediction of magnitudes and directions of coastal currents throughout water column to assist trajectory modeling predictions and on-site coordinator.

      (2) Identification of research needs for the development of adequate models of coastal currents and baseline current data.

   B. Procedure:

      (1) Information to modelers and on-site coordinator provided by

         (a) Emperical current measurements - current meter array, bottom observations (topography) and drifters.

         (b) Regional reference document.

         (c) Simple analytical current models and for tabulated current tables.

   C. Anticipated Result: Surface, mid-depth and bottom velocities due to:

         (a) Tide

         (b) Wind driven currents

         (c) Density currents

         (d) Wave-current interaction.

3. Performing Organization:

A. Organization with capability:

(1) Woods Hole Oceanographic Institution

(a)	Dr. Robert Beardsly Dr. Gabriel Csanady	Physical Oceanography
(b)	Dr. William D. Grant Dr. Albert J. Williams	Ocean Engineering

(2) Massachusetts Institute of Technology - Dr. Ole S. Madsen, Civil Engineering.

(3) USGS-Woods Hole - Dr. Brad Butman.

(4) NMFS - Woods Hole.

(5) Univ. of R.I., Dr. Malcolm Spaulding, Dr. Peter Cornillon, Dr. C. Griscom, Dr. R. McMaster, Dr. J. Fisher, Dr. J. Boothroyd.

(6) Univ. of Conn. - Dr. Frank Bohlen.

(7) EG&G - Dr. Richard Scarlet.

B. Possible performing organization - all of the above.

4. Applicable Habitat:

Coastal Zone, i.e., region where frictional influence of bottom is felt through water column. 30 to 40m depth contour.

5. Applicable Conditions:

a. Oil spill occurs in shallow coastal region.

b. Trajectory predictions show likely impingement in coastal region.

6. Applicable Oil Type:

All

7. Time Frame:

a. Predictions for on-site use could be provided almost immediately by empirical methods.

b. Longer term research is needed to develop adequate models of wind-driven currents, wave-current interaction models, and adequate descriptions of the forcing involved.

c. In the event that oil reaches bottom sediments, longer term monitoring of the currents will be needed to determine direction of potential oil laden sediment transport.

8. Cost:

$30K (only for immediate monitoring - no research cost included).

9. Equipment Needs/Equipment Available:

a. Current meters capable of resolving both wave and current flows:

(1) E/M Current Meter

(2) Accoustic Current Meters

(3) CTD measurements

(4) Bottom observations, i.e., bottom camera or divers.

b. Woods Hole Oceanographic Institution, if available

University of Rhode Island

Massachusetts Institute of Technology.

NMFS Woods Hole

10. Facility Needs/Facilities Available:

a. Ships to deploy current meters; computer to run simple current models.

b. Woods Hole Oceanographic Institution (ship & comp.)
Massachusetts Institute of Technology (ship & comp.)
URI. NMFS Woods Hole.

11. Personnel Needs/Personnel Available:

See item 3a.

12. Support Services:

    a. Mapping of spill.

    b. Meteorological data.

13. Payoff:

    a. Contribution of assessment of ecological impact:

        (1) Necessary input to trajectory model

        (2) Support service to determine ultimate fate of spill.

    b. Scientific Interest:

    Research into: wind-driven currents, wave-current interaction, and partitioning of wind stress into currents/waves. These topics are of interest for a wide range of pollution studies besides oil.

14. Limitations:

    a. Availability of current meters/personnel

    b. Weather conditions for deployment

    c. Present models of wind-driven currents and wave-current interactions are crude but possibly adequate for initial trajectory predictions when backed up by empirical measurements. Future predictions over longer time periods requires a better knowledge of these; i.e., depth average current models are not adequate.

WATER COLUMN BIOLOGY PANEL

Participants

F.G. Lowman, Chairperson

O.T. Edstrom	H. Mulligan
R. Gerber	C.L. Rogers
P.E. Hargraves	C. Ross
D.L. Harvey	J. Snider
G. LaRoche	G.A. Vargo

WATER COLUMN BIOLOGY PANEL

General Considerations

The information on the subject of water column biology is presented in several major sections, according to the source of the information. The major components of the Water Column Biology Panel report are as follows:

- Projects recommended at Hartford.
- Comprehensive package submitted by the NMFS Northeast Fisheries Center submitted after the Workshop, including substantial background information and ten proposed projects.
- Addendum to the Panel report giving general considerations on pertinent methods.

Numbering of the projects is continuous through the Panel report. Thus projects 1-3 were proposed at Hartford and projects 4-13 were submitted by NMFS after the Workshop.

WATER COLUMN BIOLOGY PANEL

Recommended Projects*

1. Possible responses to oil spills: analysis of plankton.
2. Effects of oil spills on resident fish communities.
3. The effects of oil spills on icthyoplankton: eggs and larval stages.
4. Ichthyoplankton survey - MARMAP Survey I.
5. Bottom trawl survey operations - MARMAP Survey II.
6. Demersal food chain investigations.
7. Physiological and biochemical effects of an oil spill on selected fish and shellfish.
8. Histopathological effects of an oil spill on marine organisms.
9. Hydrocarbon analyses of fish, shellfish, zooplankton.
10. The genetic effects of an oil spill on developing fish embryos.
11. Toxicity studies: The effects of oil on developing fish embryos and larvae.
12. Phytoplankton and other microorganisms.
13. Fishery oceanography: Environmental studies.

Addendum: General Methodology Considerations

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*Projects 1-3 proposed at Hartford, projects 4-13 submitted by NMFS Northeast Fisheries Center after the Workshop.

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 1
PRIORITY RANK:

1. Project Title: Possible Responses to Oil Spills: Analysis of Plankton

2. Project Description:

Objective: Determination of short-term effects of oil spills on plankton populations.

A. Unquestionable need for a data base - centralization of existing literature and the means to acquire and update additional data. See also Project No. 3, Effects of Oil Spills on Ichthyoplankton 2.D Baseline Data.

B. Interactions and coordinations with laboratory experimentation; standardization of experimental techniques, e.g., bioassay studies - standardization of simple rapid bioassay test which can be performed (initiated?) in the field and duplicated (continued?) in the lab.

C. Groups to be examined

(1) Phytoplankton. For species composition, measurement of productivity, and community dynamics, fractionation into net and nanoplankton is essential. Measurements should include C, N, and ATP analyses, along with other analyses such as total biomass and chlorophyll.

(2) Heterotrophic microplankton. Species composition and abundance of such groups as protozoa (tintinnids, other ciliates, amoebae, flagellates) and larvae stages of planktonic invertebrates. A physiological measurement such as respiration is desirable but methodology is not perfected.

(3) Other zooplankton (pelagic crustaceans, ichthyoplankton and others). Species composition distribution and abundance. Respiration, ingestion, and excretion measurements are desirable. See also Project No. 3, on the Effects of Oil Spills on Ichthyoplankton 2.B.

(4) Particulate organic matter. Estimates of abundance and total carbon contribution.

(5) Bacterioplankton. Marginally understood, but should be considered.

D. Measurements of hydrocarbons necessary in all size categories: with larger sizes, separation at trophic level should be possible (e.g., carnivores vs. herbivores). At smaller size levels, trophic separation is probably not feasible.

E. Sampling techniques - See Water Column Biology Addendum.

3. Performing Organization:

See Project No. 3 on The Effects of Oil Spills on Ichthyoplankton.

4. Applicable Habitats:

Habitats are all coastal areas to the limits of the continental shelf where significant economic or aesthetic impact could occur.

5. Applicable Conditions:

Any.

6. Applicable Oil Types:

The project applies to all types of oil. The experimental format should be flexible according to oil type.

7. Time Frame:

The time required for on-site investigations is dictated by the duration of analysis and the finalized experimental design. This will vary with the scope of the investigation, nature and size of the spill, etc. In all cases a maximum flexibility in response should be maintained.

8. Cost:

A supply of capital equipment should be maintained sufficient to support all planned projects. A fund of readily available money should be maintained in order to insure and promote rapid and intensive responses to any spill. Such a fund should include guaranteed expenses plus, in the case of state and university commitments, overhead costs. For details see projects entitled Effects of Oil Spills on Resident Fish Communities and Effects of Oil Spills on Icthyoplankton.

9. Equipment Needs:

All equipment should be standardized and readily accessible. Samplers should be those that do not damage the organisms sampled (e.g., large volume water samplers).

10. Facility Needs:

Depending on the size of the spill, investigations should be coordinated at local levels (small spills) or regional levels (large spills). For more sophisticated experiments, a centralized laboratory should be available and designated. Availability of vessels and aircraft should be designated, as well as an organized local liaison center. All experiments relating to spills should be coordinated from a central facility, such as EPA-Narragansett or NMFS-Woods Hole.

11. Personnel Needs:

A centralized listing of personnel in the areas named in category #2 should be maintained and widely distributed. Since many of these projects involve considerable time and expense, a regional or national fund guaranteeing support should be available for dispensation of seed funds at short notice.

Addenda: At this stage of organization it is premature to be overly specific in design and analysis of experiments and specific methodology. Each project has different requirements and each oil spill requires a different response.

Investigators should not have preconceived expectations of results. The complexity of marine food webs is such that adequate answers can come only from carefully considered experimentation and analysis.

12. Support Services:

- Horizontal and vertical distribution of pollutant with time
- Oil analysis support
- Communications (field)
- Freezer space and shipping support
- Interaction with other activities and disciplines associated with oil spill
- Medical support and facilities

13. Payoff:

Estimates of the degree of petroleum contamination should be made for the first two trophic levels of the food web, the phytoplankton and the zooplankton, to determine the impact of contamination on the species composition and abundance of the phytoplankton and zooplankton.

14. Limitations:

Due to the effects of rapid recruitment, high reproductive rate and natural patchiness of plankton, it may be difficult to definitely attribute detectable alterations to the plankton populations.

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 2
PRIORITY RANK:

1. Project Title: Effects of Oil Spills on Resident Fish Communities

2. Project Description:

   A. Determine petroleum hydrocarbon levels in resident species in and near site of spill.

   B. Determine impacts of the spill on the resident species.

   o Short-term possible studies include:

   - Stomach analyses for food chain PHC contamination
   - Flesh analysis for PHC
   - Blood plasma-ion imbalance
   - Instant mortality
   - Depuration rates(?)
   - Enzyme activity
   - Histopathology
   - Behavior analysis
   - Stamina testing and respiration rates
   - Tainting

   o Long-term possible studies include:

   - Blood plasma-ion imbalance
   - Fecundity (eggs/gm/gravid female)
   - Behavior (avoidance included)
   - Stamina testing
   - Histopathology
   - Recruitment (sex ratios)
   - Condition coefficient gut analysis
   - Tainting
   - Respiration rates

3. Performing Organization:

   See project entitled: Effects of Oil Spills on Icthyoplankton.

4. Applicable Habitats:

   Pelagic and benthic resident fishes to the continental shelf.

5. Applicable Conditions:

Major spills per lead agency definition and safe sampling conditions.

6. Applicable Oil Type:

Any oil type except those of low flash points that would subject field crew to unnecessary hazards from inhalation or fire.

7. Time Frame:

Duration of the study depends on the conditions, type of oil, area of the spill and the monies available.

8. Cost:

For all water column species (plankton and finfish) including cost of gear, ship time, screening analysis (3000 samples); 10 investigators ($30K) $150K; ship time (inshore $20K, 30 days) includes gear and operating expense (offshore $320K, 30 days); total estimate $200K inshore; total estimate $500K offshore; plus 100 detailed analyses ($50,000).

9. Equipment Needs:*

	Estimated Value
Fisheries	
A. Hook and line (D) complete	$ 500.00
B. Gill nets (D) 15 @ $200 apiece	3,000.00
C. Shrimp trynets (D) including boards	3,000.00
D. Trawls (bottom and midwater) (D) 5 replacement nets	4,000.00
E. Explosives (D)	500.00
F. Vessels (minor maintenance)	1,000.00
G. Disposable sampling equipment (D) bottles, plastic bags, aluminum foil, ice, ice chests, etc.	4,000.00

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*(D) = disposable

10. Facility Needs:

A. Docking launching facility

B. Vessels and laboratory to perform services. If needed, helicopter time is $200/hr. - 20 hrs. The availability of local State and Federal military aircraft should be checked. Lodging, etc., should be handled by the executive director.

11. Personnel Needs:

See #3 for agencies and organization.

12. Support Services:

A. Horizontal and vertical distribution of oil.

B. Oil analysis support.

C. Communications (mobile).

D. Freezer and shipping support.

E. Interaction with other activities and disciplines associated with that oil spill.

F. Medical facilities and support.

13. Payoff:

With a well-coordinated interdisciplinary program, this project could assess the total impact of an oil spill on resident fish populations. Loss of resident fish populations may affect distribution and availability of migratory species. Total factors could have adverse local economic impacts.

14. Limitations:

It is difficult to determine whether detectable alterations to fish populations in the vicinity of an oil spill are related directly to that event.

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 3
PRIORITY RANK:

1. Project Title: The Effects of Oil Spills on Ichthyoplankton: Eggs and Larval Stages

2. Project Description:

A. Objective: To determine the effects of petroleum hydrocarbons on developing fish embryos and larvae. Studies will be carried out on embryos and larvae collected from an oil spill area and additional controlled laboratory studies will be conducted in order to estimate the impact of a spill on this fragile and highly important component of the plankton community.

B. Procedure:

(1) Sampling

Neuston and plankton samples will be collected at regular areal and temporal intervals following a spill. Details of standardized sampling procedure can be found in Water Column Biology Panel Addendum. Samples will be preserved in 4 percent buffered formalin. Contents from the 0.505 mm mesh plankton net and the neuston samples will be sorted for ichthyoplankton. The species composition and numbers of fish eggs and larvae will be calculated for 100 m^3 water filtered. From this, estimates of species distribution and abundance can be made and compared with data from previous years to give an estimate of initial impact (see D. Baseline Data).

Before preservation the sample should be observed for the condition of eggs and larvae (i.e., oil on eggs, dead eggs or larvae).

The zooplankton (0.333 mm mesh samples will also be analyzed for species composition, abundance and distribution. This information will be used as part of Project No. 1. Although ichthyoplankton and the other plankton groups have been separated into two projects, sampling for both groups is simultaneous. Standard sampling methods are described in the Water Column Biology Addendum.

(2) Genetics

Preserved eggs from plankton and neuston tows should be sorted by species and stage. They can then be examined for genetic damage. Using the methods of Longwess (1976) the extent (%) of damage can be estimated, i.e., morbidity, moribundity, abnormal embryos and chromosome damage for that sample (see *Argo Merchant* ICES Report). The results can be compared for samples from clean and impacted areas and for historical data.

(3) Histopathology

Preserved larvae from oil spill and clean areas can be examined and compared for histological differences.

(9) Bioassay Studies (*in situ* and laboratory)*

Bioassays can be carried out for both egg and larval stages. Laboratory produced embryos will be brought out to sea and exposed to water pumped from areas beneath the slick, at the periphery of the slick and in "clean" areas. Water samples will be collected and analyzed for petroleum hydrocarbons. Samples will also be collected for dissolved oxygen (DO) and salinity determinations. Embryos will be exposed at different stages of development, and subsamples will be made including heartbeat, sinking (due to osmoregulation difficulties), respiration and yolk utilization. Similar studies will be conducted under laboratory conditions using known concentrations of fuel oil types (e.g., crude, Nos. 6, 4, 2) and the water soluble fractions (Kuhnhold).

The same procedures, both field and laboratory (excepting genetics studies) can be carried out for larvae. When larvae are used, feeding initiation, feeding, swimming behavior, respiration, RNA/DNA ratios, protein synthesis, growth and yolk utilization can be used to determine the effects of hydrocarbons on the larvae. In addition, histopathological studies can be carried out on preserved specimens.

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*These studies should be carried out at regular intervals from beginning of the spill. Nonetheless, if weather conditions do not permit, sampling should proceed whenever conditions are suitable.

C. Flow Diagram: A flow diagram of field and laboratory studies is presented in the Water Panel Biology Addendum.

D. Baseline Data: The National Marine Fisheries Service (NOAA) has been conducting plankton (ichthyoplankton, zooplankton) and groundfish cruises from Cape Hatteras to Nova Scotia for the last 6 and 15 years respectively. Most of these samples have been analyzed so that baseline data on species composition, abundance and distribution over time is available. This information should prove invaluable for estimating impact on fishery resources in the event of future oil spills.

3. Performing Organization:

- Rhode Island

  State Department of Natural Resources Ocean Division

  State Department of Health

  University of Rhode Island

  Environmental Research Laboratory, EPA, Narragansett, RI

  NOAA/NMFS Laboratory, Narragansett, RI

  U.S. Coast Guard, Newport

- Connecticut

  State Department of Environmental Protection Division of Conservation and Preservation

  Wesleyen University

  University of Connecticut

  State Department of Health

  NOAA/NMFS Laboratory, Milford

  Essex Marine Laboratory

  U.S. Coast Guard

- Massachusetts

  Executive Office of Environmental Affairs

    Division of Environmental Quality

    Division of Marine Fisheries

  Woods Hole Institute of Oceanography

  NOAA/NMFS Laboratory, Woods Hole, MA

  U.S. Coast Guard

  EG&G Bionomics, Waltham, MA

  EG&G Env. Consultants, Waltham, MA

  Northeastern University Marine Lab - Nahaut, MA

  University of Masschusetts Marine Lab, Rockport, MA

- New Hampshire

  New Hampshire Department of Fish & Game, Concord, NH

  New Hampshire Water Supply & Pollution Control Comm., Concord, NH

  University of New Hampshire, Office of Marine Research, Durham, NH

  State Department of Health

- Maine

  Department of Inland Fisheries, Bangor, ME

  Department of Marine Fisheries, Hanlon, ME

  Bigelow Marine Laboratory, Boothbay Harbor, ME

  University of Maine Darling Center, Walpole, ME

  State Department of Health Marine Research Laboratory

  Bowdoin College, Brunswick, ME

- Other

  NOAA/NMFS Laboratory Sandy Hook, NJ

  NOAA/NMFS Laboratory Oxford, Md

4. Applicable Habitats:

   All coastal and shelf waters.

5&6. Applicable Conditions and Oil Type:

   A major spill of any petroleum oil type except those with low flashpoints that would subject the field crew to unnecessary hazards from inhalation or fire. The assumption is made that with either a surface application or offshore rig blowout, the pollutant will occur in the water column.

7. Time Frame:

   The time required will be determined by the financial support available and the urgency of subsequent spills.

8. Cost:

   The cost is for sampling of all water column species for 30 days.

   - Inshore (includes projects dealing with ichthyoplankton, zooplankton and adult fish populations).

Investigations	$ 30,000	
Screening	150,000	(3000 samples)
100 detailed analyses	50,000	
Inshore boat time and gear	30,000	
Living Accommodations		
	$260,000	

- Offshore

Investigations	$ 30,000 (salaries and fringe benefits)
Screening	150,000
100 detailed analyses	50,000
Offshore ship	320,000
	$550,000

9. Equipment Needs:

   A. Ship or boat suitable for the spill area with winch 61 and 20 cm paired bongo frames.

   B. 0.5 X 1.0 m frame (neuston)

   C. Nets - plankton 0.333 mm, 0.505 mm, 0.253 mm, 0.165 mm, neuston 0.505 mm mesh, clips, rope, wire depressors, jars, formalin, sieves, buckets, labels, submersible pumps.

   D. Microscopes, sorting dishes, vials, labels, jars, air stones, droppers, chemicals, stains, histological equipment, gilson respirometer, Niskin or Nansen bottles, glassware.

   E. Centrifuge.

10. Facility Needs:

    A. Vessel

    B. Helicopters

    C. Laboratory

11. Personnel Needs

    See Item 3 for agencies and organizations.

12. Support Services:

    A. Horizontal and vertical distribution of pollutant with time

    B. Oil analysis support

C. Communications (field)

D. Freezer space and shipping support

E. Interaction with other activities and disciplines associated with that oil spill

F. Medical support and facilities

13. Payoff:

Estimate of the degree of petroleum contamination of fish eggs and larvae would be made. An estimate of the effects on future marine stocks may not be possible.

14. Limitations:

It is improbable that detectable changes in biota following an oil spill could be related exclusively to the incident under study.

OFFSHORE OIL SPILL ECOLOGICAL DAMAGE ASSESSMENT PLAN FOR FISHERIES

The National Marine Fisheries Service
Northeast Fisheries Center

Narragansett Laboratory
Narragansett, RI 02882
February 6, 1978

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INTRODUCTION

The success of any effort to assess the environmental impact of an oil spill depends largely on having adequate baseline data and being able to conduct long-term investigations. The studies initiated at the time of a spill can answer questions regarding immediate catastrophic effects of the spill. These are necessary. However, it is the long-term sublethal impacts of chronic exposures of an ecosystem to petroleum hydrocarbons that need to be evaluated. Such effects can be detected or recovery measured only through long-term monitoring.

The Northeast Fisheries Center of the National Marine Fisheries Service carries out marine ecosystem research off the Northeast coast including the Gulf of Maine, Georges Bank and the Mid-Atlantic Bight. In addition to providing assessments of the status of fish stocks, information is also obtained on the physiological condition or health of the marine ecosystem. Population estimates are obtained largely through interviews with fishermen and analyses of fish catches combined with fishery independent survey information. Surveys of fish and ichthyoplankton are carried out through the MARMAP (Marine Resource, Monitoring, Assessment and Prediction) program. There is also a growing concern about the effects of marine pollution, not only on the yield of fisheries resources, but also on the health of human populations. Current studies of pollutants in the marine environment are site specific and of short duration. Through the Ocean Pulse program the NEFC coordinates its studies and the studies of other groups to determine the wide, long-range effects of marine pollution on the ecosystem and to distinguish between effects due to contaminants and those due to natural factors.

These two programs, MARMAP and Ocean Pulse, are carried out by six principal Divisional elements located within the NEFC. They are Resource Assessment, Marine Ecosystems, Resource Utilization, Environmental Assessment, Aquaculture, and Pathobiology. These activities are carried out at six laboratories: Woods Hole, MA; Gloucester, MA; Narragansett, RI; Milford, CT; Sandy Hook, NJ; and Oxford, MD. The Atlantic Environmental Group, Manned Undersea Research and Technology program and National Systematics Laboratory support the divisional investigations.

In addition to long term monitoring of fishery resource distribution, abundance and health, the NEFC also has the capability of making short-term risk analyses of an oil spill through the expertise of the Atlantic Environmental Group and the Fishery Oceanography Investigation of the Marine Ecosystem Division. Long-term environmental information on currents, eddies, winds, Gulf Stream meanders and warm core eddies along the Slope and Continental Shelf are used to make predictions on the expected movement and fate of an oil spill. Through these predictions it is possible to plan the appropriate short- or long-term studies to assess the impact of a spill.

RESEARCH PROGRAMS
National Marine Fisheries Service
Northeast Fisheries Center

Research to support fisheries management focuses on predicting changes in the size, composition, and structure of the fisheries resources off the Northeast coast. This research is carried out largely through the MARMAP program. MARMAP information, when combined with data on the effects of natural and man-made environmental factors, permits the prediction of the production of fish stocks. Relevant social, economic, and/or ecological factors are incorporated into these estimates.

The principal elements of MARMAP include resource surveys, analyses of commercial and recreational fish catches, fishery oceanography, and fishery engineering. Each is necessary, but none of them is in itself sufficient for resource assessment. Data analysis tasks combine the results of surveys, catch statistics, biometric data (age, growth, fecundity, recruitment, and mortality rates) plus information on environmental conditions and food chain dynamics to produce updated stock assessments.

Two types of MARMAP Surveys are currently being conducted. One type of survey (S-I-Ichthyoplankton Appendix I) monitors changes in distribution and abundance of fish eggs and larvae. These data are used to estimate size of spawning stocks and to forecast annual recruits. Fish are sensitive to environmental changes during their early life stages, and the mortality for each year class can affect future harvests. These survey operations are conducted cooperatively with the USSR, Poland, Canada, FRG and GDR on a bimonthly basis in the Atlantic. A detailed list of cooperative surveys for 1978 is shown in Figure 1.

A second type of survey focuses on the abundance and distribution of fish and shellfish species which live at or near the bottom when they reach harvestable size, (e.g., cod, flounder, scallop, lobster, crab, and shrimp). Bottom survey operations (S-II-Ground Fish Appendix II) are conducted with several foreign nations in the Northwest Atlantic from Greenland to Cape Hatteras (Figure 2), and under contract with the State of South Carolina from Cape Hatteras to the Florida Keys. Two NOAA fleet vessels, the Albatross IV and the Delaware II, support MARMAP surveys. Surveys are also conducted by charter vessels from states, universities, and private industry.

Fishery Analysis

Assessing the condition of fisheries resources and making forecasts requires analysis of data collected from commercial and recreational fisheries and from resource surveys. These statistical analyses of population dynamics and ecology make possible the measurement of fishing

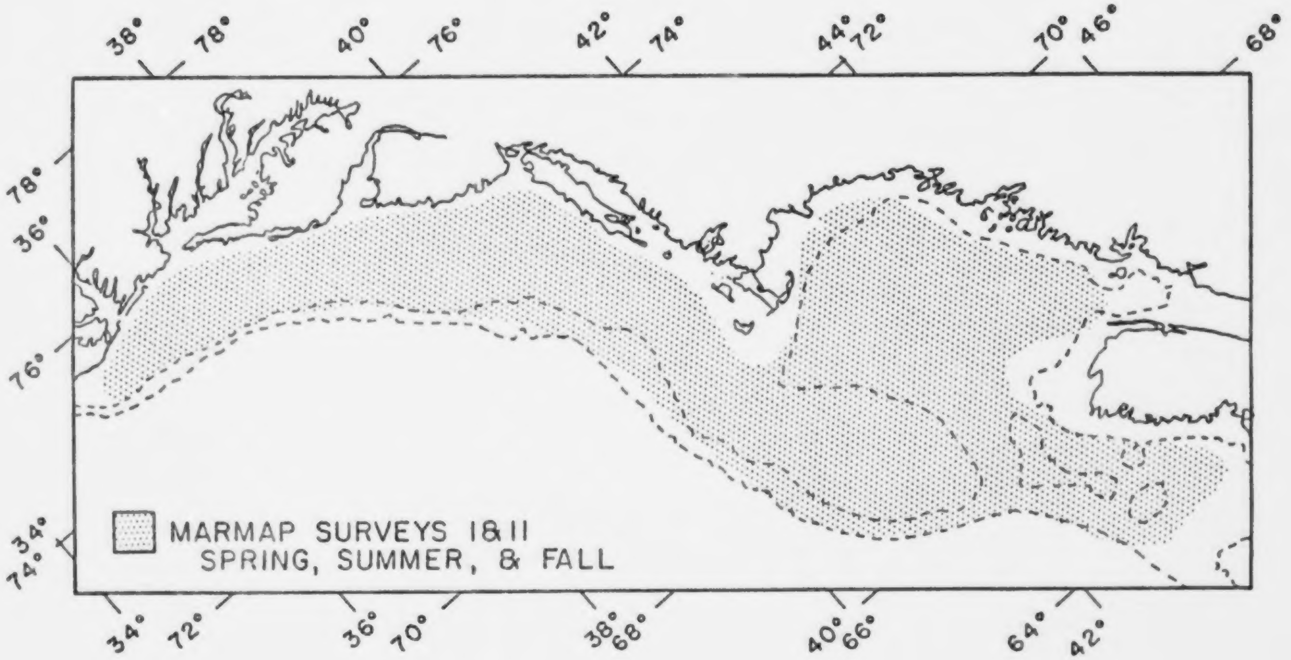

38°
78°
40°
76°
42°
74°
44°
72°
70°
46°
68°
78°
36°
76°
34°
74°
MARMAP SURVEYS I & II
SPRING, SUMMER, & FALL
34°
72°
36°
70°
38°
68°
40°
66°
64°
42°

Figure 2.

and natural mortality rates, and of annual changes in abundance caused by fishing or environmental changes. These analyses are used to construct yield curves and population models, to make stock abundance forecasts, and to produce status-of-stock reports for input to management decisions. MARMAP reports include two nationwide summaries, one on the annual conditions of the principal stocks off the US coasts that provides assessment information on 31 species and groups encompassing 99% of the volume and value of the US marine fishery resource. The other is a summary of annual environmental changes that have actual or potential effect on the distribution and abundance of fish stocks. Assessments are based on a series of investigations which begin with the identification of a resource, its distribution, and number of component stocks and procedes through measurement of mortality rates and other parameters. The synthesis of such data provides the basis for yield forecasts and management recommendations. MARMAP assessments are provided to the newly established Fishery Management Councils, international, State-Federal and industry commissions, and associations charged with the development or management of the various fisheries. Assessments are made both on individual species and on the total biomass. In addition, approximately 400 technical and scientific reports are produced annually which provide assessments of fish species and the more abundant plant and invertebrate populations that support the fish stocks of the region.

Fishery Oceanography

Changes in physical and chemical properties of the ocean (currents, temperature, nutrients, etc.) affect not only long-term yields and annual abundances of fish stocks, but also their distribution. The impacts of man's activities (fishing, pollution, environmental modification) and of natural environmental processes on the annual production of fish crops need to be accurately predicted. MARMAP oceanography activities include the analyses of physical, chemical, and biological oceanographic data collected during MARMAP surveys and from oceanographic research activities of other agencies. Special MARMAP studies are conducted with the USSR to obtain organic production and larval survival data and to develop ecosystem models for the Northwest Atlantic.

Physiological Effects of Pollution

Research for environmental management provides information on the natural variability and pollution caused by man's activities in the Northwest and Middle Atlantic. This information obtained by NMFS/NEFC program called Ocean Pulse comes from conducting baseline studies of the occurrence of marine contaminants and their effects on commercially, recreationally, and/or ecologically important species, and from monitoring changes in water movements, temperature, and dissolved oxygen concentrations. These baseline studies and monitoring efforts often include sewage sludge dump sites, dredge spoils, industrial chemicals, power plant thermal effluents, and oil spills, in order to determine the effects of site-specific contamination on the health of the marine ecosystem and its fisheries resources.

Ocean Pulse monitors the physiological condition of marine communities in both clean and impacted areas up to six times annually (Figure 3). This includes physiological, biochemical, behavioral, genetic and histopathologic studies as well as systematic monitoring of pertinant environmental variables. Changes in condition due to stress caused by pollution can be detected, characterized and evaluated against the long-term monitoring by the MARMAP program.

Short-term site-specific studies carried out in the wake of an oil spill must be integrated with and compared to long-term population monitoring baseline data supported by physiological effects studies if the impact of acute events on an ecosystem are to be evaluated.

The principal research activities of NEFC are conducted within a divisional matrix. A brief description of each of the Center operational elements is given below and a summary is presented in Appendix III.

1. RESOURCE ASSESSMENT DIVISION

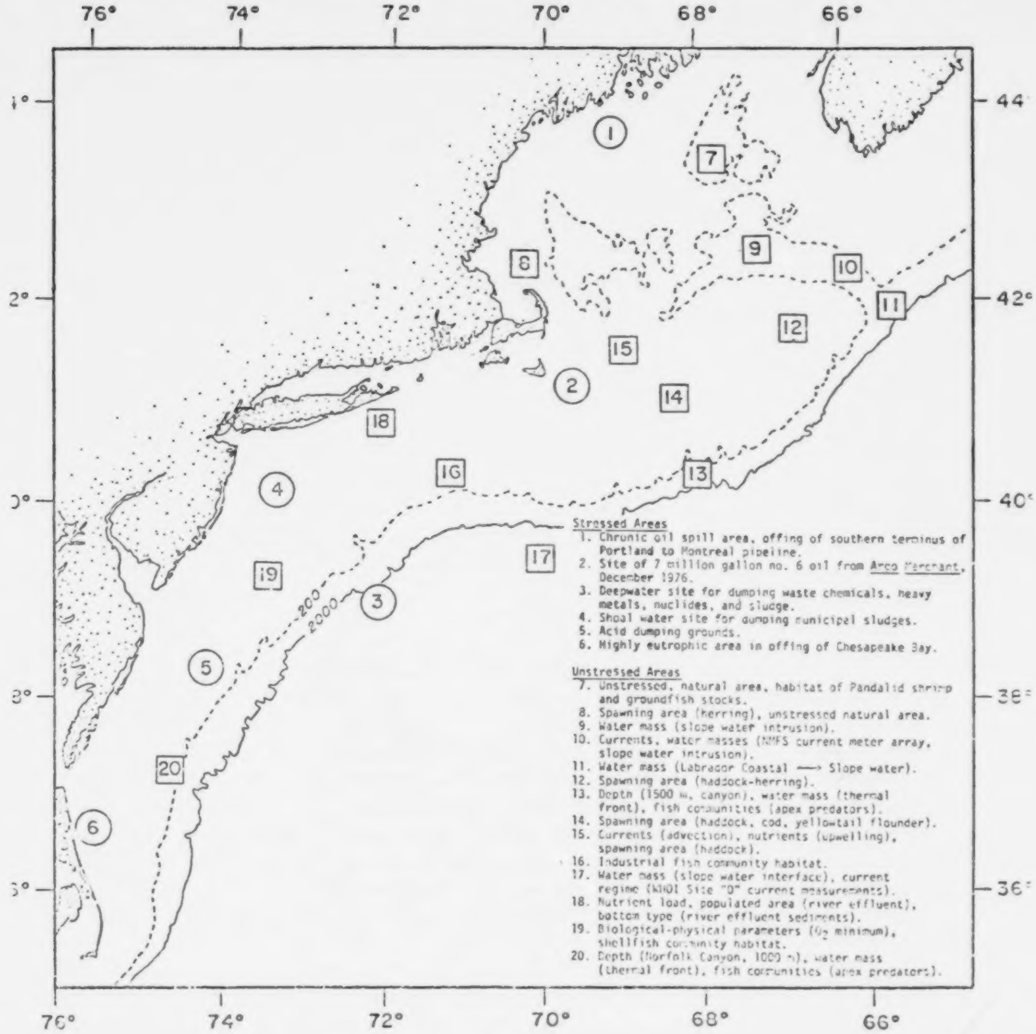
The role of the Resource Assessment Division is to assess the effects of harvesting on fisheries resources. To do this assessment, the Division estimates the relative and absolute abundances; spatial and temporal distributions; and harvestable numbers, sizes, and weights of finfish, shellfish, and crustaceans in the Northwest Atlantic; and determines the productivity of these renewable marine resources from an ecosystem standpoint. To accomplish these tasks, the Division analyzes both domestic and foreign data from commercial fisheries, recreational fisheries, and research surveys. Additional economic and biological studies provide data for modeling the fisheries to aid in their management for optimum sustainable yield.

1.1 Resource Surveys Investigation

Each fall, spring, and summer the Resource Surveys Investigation surveys with bottom trawls the fisheries resources of the continental shelf from Nova Scotia to North Carolina. These surveys are part of the Marine Monitoring, Assessment, and Prediction (MARMAP) Program's Survey-II effort to document the relative abundance and distribution of these resources in the area. Supplementary surveys of the area occur regularly, many as cooperative efforts with other nations that fish in the Northwest Atlantic. These supplementary surveys often gather information that is not gathered in the semiannual surveys such as the seasonal/areal distribution of surf clams.

The standard data that are recorded on these various surveys are the length, weight, age, and maturity of the fish, and the temperature and depth of the water where captured. Ichthyoplankton samples and other hydrographic data are also often collected. Such data reveal changes in the size, composition, or structure of the fisheries resource. Some of the important species for which these data are

Figure 3. Tentative Sampling locations for the Ocean Pulse Program



Stressed Areas

1. Chrunic oil spill area, offing of southern terminus of Portland to Montreal pipeline.
2. Site of 7 million gallon no. 6 oil from *Arco Merchant*, December 1976.
3. Deepwater site for dumping waste chemicals, heavy metals, nuclides, and sludge.
4. Shoal water site for dumping municipal sludges.
5. Acid dumping grounds.
6. Highly eutrophic area in offing of Chesapeake Bay.

Unstressed Areas

7. Unstressed, natural area, habitat of Pandalid shrimp and groundfish stocks.
8. Spawning area (herring), unstressed natural area.
9. Water mass (slope water intrusion).
10. Currents, water masses (NMFS current meter array, slope water intrusion).
11. Water mass (Labrador Coastal ⟶ Slope water).
12. Spawning area (haddock-herring).
13. Depth (1500 m, canyon), water mass (thermal front), fish communities (apex predators).
14. Spawning area (haddock, cod, yellowtail flounder).
15. Currents (advection), nutrients (upwelling), spawning area (haddock).
16. Industrial fish community habitat.
17. Water mass (slope water interface), current regime (WHOI Site "D" current measurements).
18. Nutrient load, populated area (river effluent), bottom type (river effluent sediments).
19. Biological-physical parameters (O_2 minimum), shellfish community habitat.
20. Depth (Norfolk Canyon, 1000 m), water mass (thermal front), fish communities (apex predators).

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collected are haddock, Atlantic cod, yellowtail flounder, silver hake, red hake, white hake, Atlantic herring, Atlantic mackerel, spiny dogfish, long-finned squid, and American lobster.

To complement the bottom trawl surveys, the investigation works on the development of hydroacoustical methods to survey pelagic fishes. Such work ranges from the study of the echo strength and pattern of a given size and species of fish, to the correlation of the hydroacoustical survey of an area with the actual net catches of fish from that area.

Finally, the investigation researches and develops systems for improving the efficiency of such surveys. One system currently under study will automatically log data while at sea. This automatic data logger records data systematically from on-board, automatic sensors, and stores them on magnetic tape in a form that can be directly interpreted by digital computers once on shore. Such a system permits an instantaneous correlation of biological data with physical and chemical data.

1.2 Age and Growth Investigation

The objective of this investigation is to determine species/stock growth rates and the age compositions of both the harvested and total populations. Information on this aspect of the population dynamics of various species/stocks is needed to assess productivities of species/stocks of the Northwest and Middle Atlantic. The investigation also works on the development of systems to aid in its research such as a computerized system for automatically determining age and growth from scales and otoliths. Among the species aged in this investigation are bluefish, butterfish, haddock, yellowtail flounder, Atlantic herring, Atlantic cod, silver hake, redfish, pollock, white hake, and Atlantic mackerel.

1.3 Fisheries Statistics Investigation

Fisheries statisticians perform both data reduction and data analysis. These data come from catch and effort statistics of research surveys and recreational and commercial fisheries, and from biological statistics of fish sampled in such surveys and fisheries. Foreign surveys and fisheries also contribute data for the reduction and analysis processes. With this information the investigation assesses the size, composition, and structure of the individual fish stocks and the total fish biomass of the Northwest and Middle Atlantic.

These assessments form the basis for a finer analysis. The investigational staff analyzes the effects of different fisheries management regimes such as optimum sustainable yield on the stocks and biomass. The researchers also evaluate the effects of different levels of catch and effort on the fishing mortality of a given stock. Since these analyses and evaluations often require the analysis and evaluation of the ecosystem as a whole, this investigation relies heavily upon other investigations for information on the various aspects of the ecosystem.

1.4 Fisheries Socioeconomics Investigation

The Fishery Conservation and Management Act of 1976 requires that the optimum sustainable yield of a fishery be determined by modifying the estimate of maximum sustainable yield by "relevant economic, social, or ecological factors." The Fisheries Socioeconomics Investigation establishes and maintains a socioeconomic data base and conducts the analyses needed to define optimum sustainable yields, surpluses, and allocations of fisheries resources to both commercial and recreational interests. The investigation develops economic profiles for various fisheries, including the economic value of the fishery, the recreational and commercial income of the fishery, and the capacity for harvesting and processing the catch. Econometric models are also constructed to evaluate the economic consequences of various management options. Sociological factors are a significant component of these models.

1.5 Sandy Hook Investigation

Several of the Resource Assessment Division's key people operate out of the Sandy Hook Laboratory. These people serve as a critical link to personnel and problems in the Middle Atlantic area by performing a variety of the duties with the Division in that area. Currently, these individuals are analyzing data from a creel survey of party and charter boats in New Jersey to estimate biostatistics from that important recreational fishery and to develop improved survey techniques. They are also monitoring specific fisheries, such as a study of the Middle Atlantic fisheries for the Atlantic cod and an investigation of fecundity and other biological parameters for the Atlantic mackerel and the Atlantic croaker. Sandy Hook individuals are also deeply involved in developing mid-water trawling procedures for monitoring inshore summer fish abundances.

1.6 Fisheries Analysis Investigation

This investigation focuses on modeling both the population and ecosystem dynamics of the commercially, recreationally, and ecologically important fishes in the Northwest and Middle Atlantic. Of the traditional fields of population dynamics--population size, age-growth, mortality-yield, and stock-recruitment--the first three undergo primary study by other investigations in the Division (Resource Surveys, Age and Growth, and Fisheries Statistics, respectively). The Fisheries Analysis Investigation integrates the results of these studies and primarily or secondarily investigates all four fields.

For the ecosystem dynamics approach, the staff considers the effects of natural and man-made environmental factors on interspecific competition and any resultant changes in the size, composition, or structure of the biomass. Socioeconomic interactions developed by the preceding investigation are also included in these fisheries models to aid fisheries managers in determining optimum yields.

2. MARINE ECOSYSTEMS DIVISION

Studies of the population dynamics of each species within a fishery do not by themselves provide the necessary information to manage effectively a multispecies fishery, especially one in which the sought-after species occupy different trophic levels. It is important to understand the population dynamics of individual species, but it is also important to understand the effect that the change in the distribution, abundance, and age structure of one species has on the other species in the ecosystem.

The 50% decrease in the number of finfish off the Northeast and Middle Atlantic States during the past decade, principally due to increased fishing effort, raises some significant questions. Does the reduction due to fishing of major predatory species such as Atlantic mackerel, haddock, Atlantic herring, yellowtail flounder, and Atlantic cod release major prey species such as certain zooplankters to be consumed by shorter-lived, faster-growing, smaller-sized, and less desirable predatory species? And, what are the probabilities of a return of over-exploited fish species to former abundance levels and former habitats?

Studies in the Marine Ecosystems Division address these questions. The studies focus on the critical links between the principal sources of fish food and the survival, recruitment, and productivity of the principal fish stocks sought after by fishermen.. The availability of fish stocks to domestic fishermen is an end product of a complex series of events and interactions located: at the ocean bottom with the benthic food of groundfishes; in the water column with the zooplanktonic food of pelagic fishes; and in the changing physics and chemistry of moving water and weather conditions.

2.1 Ichthyoplankton Investigation

Ichthyoplankton studies deal with the community dynamics of larval fishes in the Continental Shelf waters from western Nova Scotia to northern North Carolina. To understand these community dynamics, the ichthyoplankton biologists are investigating the factors that control species dominance in larval fish communities, including the influences of competition, predation, and hydrography. The staff has the principal responsibility for preparing annual forecasts of changes in the abundance levels of the principal fish species in the area.

Another area of responsibility of the investigation is to conduct and coordinate the ichthyoplankton surveys of NOAA's Marine Monitoring, Assessment, and Prediction Program (MARMAP). This coordination involves interaction with American universities and state agencies participating in the program, as well as several foreign nations (Poland, Soviet Union, East Germany, and West Germany). The investigational staff serves in a liaison capacity and monitors the ichthyoplankton sorting in the Polish-American Plankton Sorting Center in Szczecin, Poland.

The staff provides annual abundance indices of ichthyoplankton and the spawning biomass of selected species. They develop taxonomic keys for the identification of larval fishes, prepare monography on diagnostic features of fish developmental stages from egg through juvenile, and coordinate all NEFC taxonomic studies with the National Systematics Laboratory.

2.2 Benthic Dynamics Investigation

The Benthic Dynamics Investigation monitors and predicts changes in the kinds, abundances, and availability of food organisms for such bottom-dwelling fishes as Atlantic cod, haddock, and yellowtail flounder, and for such open-water fishes as Atlantic herring and Atlantic mackerel. The investigation studies the consequences of such changes in benthic food organisms on the distribution and production of demersal and pelagic fish stocks in the Georges Bank Gulf of Maine, and Mid-Atlantic Bight ecosystems. Staff members identify and enumerate important benthic food organisms, and define their environmental requirements and interrelationships with important fish stocks in the area. Another area of interest is the study of the trophodynamic relationships between pelagic and demersal species, focusing on the role of competition as a contributor to species dominance.

2.3 Plankton Ecology Investigation

The thrust of this research is the study of the influences of the abundance and availability of zooplanktonic prey on the major pelagic and demersal fish populations on the Continental Shelf, including such commercially, recreationally, and ecologically important fish stocks as the Atlantic mackerel, Atlantic herring, silver and red hakes, pollock, and sand launce. Specific research activities include: (1) the preparation of bimonthly indices of zooplanktonic abundance from western Nova Scotia to Cape Hatteras; (2) investigation of the mesoscale and microscale relationships between zooplanktonic production and larval fish survival; (3) monitoring areal and seasonal changes in zooplanktonic prey availability along the migration routes of Atlantic herring and Atlantic mackerel as part of a study of the factors controlling areal and seasonal availability and abundance of the biomass of these stocks; (4) investigation of the impact of changes in the composition and abundance of the zooplanktonic biomass on the productivity of fish in the Georges Bank, Gulf of Maine, and Mid-Atlantic Bight ecosystems; and (5) monitoring effects of seasonal and annual changes of currents and water masses on the distribution and abundances of zooplankton and their predators.

In addition, staff personnel serve as the principal liaisons in the ongoing joint studies of secondary production with the Soviet Union, poland, and West Germany, as well as oversee the operations of the Polish-American Plankton Sorting Center. The staff also develops and operates an electronic data processing system for quality-controlled data storage and analysis of zooplankton and ichthyoplankton data collected by the NEFC and other cooperating groups.

2.4 Larval Physiology Investigation

The Larval Physiology Investigation studies the energetics of larval fishes. Through laboratory experimentation and field studies the larval fish physiologists develop theories of larval growth and survival. Laboratory experiments look at, among other things, the effects of changes in the densities of zooplanktonic prey on the survival rates of larval fishes under controlled temperature conditions. Other studies focus on the linkages, both theoretical and actual, between the survival of larvae and the recruitment of harvestable-sized individuals into the fishery for such popular species as haddock, Atlantic cod, yellowtail flounder, winter flounder, and scup.

2.5 Apex Predators Investigation

This NEFC research effort looks at the effects of changes in the biomass of large predators, including sharks, tunas, and billfishes, on the commercially, recreationally, and ecologically important stocks of finfishes in the Gulf of Maine, Georges Bank, and the Mid-Atlantic Bight ecosystems. Species-specific studies of apex predators deal with age-growth relationships, mortality rates, population recruitment, migratory behavior and patterns, and trophodynamics as they relate to requirements for growth and reproduction. The investigational staff works closely with fishermen by: (1) conducting extensive tagging experiments in cooperation with recreational and commercial fishermen from Maine to North Carolina: (2) serving as the principal liaison between the NEFC and recreational fishermen in the same region; and (3) monitoring the annual changes in abundances of certain shark populations through in-depth studies of catch data from fishing tournaments conducted off the Northeast and Middle Atlantic States. In addition, the staff coordinates cooperative studies on apex predators with other governmental agencies, private groups, and foreign countries such as Poland, Canada, West Germany, and the Soviet Union.

2.6 Oceanography Investigation

Migrations of fish are not random, but are initiated and guided by environmental cues. Although fisheries scientists have been moderately successful in describing the movements of pelagic and demersal species in response to environmental changes, they have been less successful in forecasting the specific times and places (patterns) of fish movements. To forecast such fish movements, the Oceanography Investigation monitors currents, temperatures, salinities, and movements of water masses and water types to understand the influences of such oceanographic conditions on movements of those species that contribute significantly to the fish biomass (Atlantic herring, Atlantic mackerel, Atlantic cod, etc.). Research focuses on those environmental conditons that optimize survival and growth of the dominant finfishes in the Gulf of Maine, Georges Bank, and the Mid-Atlantic Bight ecosystems.

Observations are made on two scales, mesoscale and microscale. The mesoscale MARMAP surveys from western Nova Scotia to Cape Hatteras occur six times a year. Such mesoscale observations are made at sufficient intervals to monitor the movements of such fishes as the Atlantic herring, Atlantic mackerel, and Atlantic cod, and their zooplanktonic prey. Microscale studies are conducted within a given water mass to define the oceanographic factors controlling the dispersal and survival of fish eggs and larvae at selected spawning sites. Even slight changes in the transport of larval fishes by currents can influence the size of a species' entire incoming year class. Studies are also conducted on the effects of warm-core rings from the Gulf Stream and fluctuations in slope water on the oceanography of the three ecosystems mentioned above.

The investigational staff also serves as the principal liaison between NEFC fisheries oceanography studies and cooperative investigations conducted with other governmental agencies, private groups, and foreign nations (Soviet Union, West Germany, East Germany, and Canada). Additionally, periodic reports of anomalous oceanographic conditions are provided to the fishing industry and other interested parties.

2.7 Ecosystem Dynamics Investigation

This investigation develops recruitment models for both pelagic and demersal fish species, including haddock, Atlantic cod, yellowtail flounder, Atlantic herring, and Atlantic mackerel. Models of larval fish behavior are also developed to assess the effects of variations of larval and juvenile growth and mortality on these stock-recruitment relationships. The information generated by these studies permits the development of candidate models of the marine ecosystem. The models are then compared with the empirical structure, standing crop, and production of specific finfish and benthic invertebrate communities. The models of selected population processes and biological interactions are used to provide practical advice to fisheries managers in the Northwest and Middle Atlantic.

Multispecies models are developed that take into account the energy requirements of the major fish populations under different simulated management regimes. These studies will lead to the development of more efficient management strategies for dealing with the three principal marine ecosystems of interest, the Gulf of Maine, Georges Bank, and the Mid-Atlantic Bight. Initial emphasis is on the development of a mass energy model for Georges Bank. Refinements of this model will be made over the next several years.

3. RESOURCE UTILIZATION DIVISION

This major NEFC resource component assists the American fishing industry and consuming public in increasing the quantity and improving the quality of finfish and shellfish products. By working closely with representatives of the fishing industry and consuming public, the Resource Utilization Division applies available technology towards increasing the production of commercially processed fish and finds ways to use the large variety of relatively unused marine species. To improve the quality of seafoods and assure their safety, staff members study the changes that occur during storage, and design various handling processing, and preservation techniques that reduce adverse changes and enhance desirable characteristics in the product. The Division also coordinates the fisheries engineering and conservation gear development programs within the NEFC.

3.1 Shellfish Resource Development Investigation

The primary purpose of this investigation is to develop new or modified methods of handling, processing, and preserving shellfish for increasing yields and improving economics. Current activities include the development of: (1) a new technique for roller extraction of crabmeat that covers all phases of processing and product quality; (2) a method for identifying crabmeat to species; (3) handling and processing methods for underutilized offshore crab species (red crab, rock crab, and Jonah crab); (4) a test to determine the amount of shell fragments in crabmeat; and (5) more efficient processing methods for squid including handling at sea, grading, skinning, eviscerating, stripping, and new product development. A secondary purpose of the investigation is to provide technical advice to the blue crab and oyster industries.

3.2 Finfish Resource Development Investigation

This investigation attempts to develop or modify methods of handling, processing, and preserving all types of finfish for increasing yields and improving economics. The investigation contracts with industry to evaluate the effectiveness and commercial potential of prototype machines to handle silver hake, or whiting, that are smaller than can now be processed economically.

Another study seeks to upgrade the value of silver hake by developing new products and new product forms. Studies of three new silver hake products are currently underway. The investigation guarantees some fresh New England fillets as "US Grade A" to determine the effort needed to assure consumers of quality, how much consumers will pay for the guarantees, and the cost of such guarantees. Other tasks include research into the effects of feeding animals with irradiated fish, and on the future of irradiators in fish preservation.

3.3 Resource Engineering Development Investigation

This investigation is a mechanical engineering support of fisheries development activities. Since there are presently no mechanized processing lines for underutilized species like silver hake, long-finned squid, red hake, goosefish, and ocean pout, the staff adapts and modifies presently available machines or designs and builds new machines to accomplish this task. Ongoing projects include: (1) developing a device to meter additives to minced flesh; (2) designing and building a machine for eviscerating and skinning squid; (3) designing and building a machine for grading any species into several size categories; and (4) designing and building a machine for sorting a mixed bag of fish into three selected size categories. This Investigation is also concerned with the development of fishing gear to improve efficiency, selectivity, and safety, and to protect the quality of the catch. Typical developments include a quick-release branchline clip for longlining, an improved trawl door hook-up, a trap that discontinues its ability to operate when it is lost, and a removable deck-block mounting pad.

3.4 Product Standardization Investigation

The development of standards and specifications of quality for fisheries products is the principal goal of the Product Standardization Investigation. Current efforts involve the development of standards for minced fish blocks, shrimp, and fillets, and fulfilling assignments for the "Codex" international standards as designated by NMFS. Standards are developed according to the following steps: (1) conduct an industry survey; (2) prepare a draft of proposed standards and distribute to interested parties; (3) resolve any comments and publish the proposed standards in the "Federal Register"; (4) after amendment of the proposed standards based on the comments, republish them in the "Federal Register"; and (5) upon finalization of the standards, make available instructions and other inspection aids for using them. Another goal of the investigation is to recommend or develop if necessary standardized analytical procedures for evaluating the criteria of the standards.

3.5 Product Quality Investigation

This investigation tries to solve the problem of quality deterioration of fisheries products that results in resource and economic losses. The diminishing supply of frozen Atlantic cod blocks has stimulated industry interest in minced silver hake as a substitute. However, minced silver hake can become rancid and tough during frozen storage. This task minimizes this quality deterioration through proper packaging, storing at optimal temperatures, using chemical additives, or combinations thereof. Certain parameters such as fat content which vary seasonally are studied to determine their effects on storage stability. Because the mincing operation provides an excellent chance for microbial contamination, surveys are made on the microbial and organoleptic qualities of commercially minced blocks to aid in establishing standards.

3.6 Product Safety Investigation

Within this study investigators determine the possible chemical hazards in fisheries products that can result from processing or environmental conditions. One class of chemicals under study is the volatile N-nitrosamines, potent carcinogenic compounds that have been found in many varieties of cured foodstuffs ranging from pork products to fish. These chemicals are formed by the action of nitrite preservatives on amines occurring naturally in food. Marine fish can contain significant quantities of amines which can react with nitrites encountered either during processing or possibly from industrial contamination of their environment. In previous N-nitrosamine studies, hot-smoked sablefish, hot-smoked salmons, and hot-smoked whitefishes were tested to determine the effectiveness of sodium nitrite in inhibiting the outgrowth and toxin production of the bacterium Clostridium botulinum, types A and E. After defining the inhibitory range of sodium nitrite, more detailed experiments were conducted to show the minimum level of nitrite needed to inhibit the bacterium. Samples from these experiments are now being analyzed by a multidetection method that identifies 14 volatile N-nitrosamines found in foods.

4. ENVIRONMENTAL ASSESSMENT DIVISION

This NEFC effort concentrates on the physical, chemical, and biological interactions which affect the estuarine, coastal, and marine environments of the Northwest and Middle Atlantic. Research stresses the impact of man's activities on the productivity and biomass of benthic, demersal, and pelagic organisms. The Division emphasizes the effects of these activities on the interrelations between biotic and abiotic elements of the environment. Results of these studies document the impact of man on commercial and recreational stocks and their forage species. Behavioral, physiological, and biochemical studies determine both subtle shifts in normal behavior and biological processes which can indicate sublethal but significant damage to resource reproduction, recruitment, feeding, migration, and other activities.

4.1 Environmental Chemistry Investigation

This investigation studies the temporal and spatial distributions of toxic chemicals, their environmental life spans, their cycles through food chains, and their effects upon the biology, habitats, and uses of marine resources. Emphasis is currently on heavy metals and petroleum-derived and halogenated hydrocarbons like DDT and PCBs. To monitor the presence of trace metals, routine measurements of their concentrations are taken in various finfish and shellfish species from intertidal and coastal waters; in apex predators collected from Deepwater Dumpsite 106; in water; and in sediments, organic debris, and other solid components of the marine environment. Measurements are also taken of trace metals in various tissues, gametes, and other cell types from organisms exposed to known lethal and sublethal levels of toxic metals. The hydrocarbon research consists primarily of the measurement of petroleum-derived and halogenated hydrocarbons in Middle Atlantic and Gulf of Maine species in waters contaminated by urban, industrial, and agricultural wastes and runoffs. The data gathered by this effort are used to model the movement of these potentially toxic materials through benthic, demersal, and pelagic food webs.

4.2 Biological Oceanography of Stressed Environments Investigation

The objective of this study is to determine the effects of urban areas upon adjacent estuarine, coastal, and marine ecosystems and their species. This program began in the Lower Hudson Estuary and New York Bight Apex and has expanded to cover the entire Continental Shelf from Cape Hatteras to Georges Bank. Studies under various conditions of river flow, temperature, planktonic blooms, and metabolic activity will show the extent and magnitude of the effects of New York City and other metropolitan areas on Continental Shelf waters. The investigation studies phytoplankton productivity and standing stocks, species ecology and diversity, nutrient levels, hydrography, rates of water column and seabed oxygen consumption and organic matter decomposition, bacteriology, and contaminant identification. Surveillance and laboratory activities stress the frequent recurrence of phytoplankton blooms.

Emphasized in these activities are nutritional and physiological capacities of causative organisms, and phytoplankton succession and bloom development in response to nutrient supplies from pollution.

The work of the investigation is broken up into four different, but interrelated efforts. First are studies of production rates, photoassimilated carbon cycles, and phytoplankton standing stock variations. The investigational staff relates the data from these studies to man-made and natural sources of nutrients and pollutants in the Mid-Atlantic Bight. Ultimately, this research will define the relationships between primary productivity and the abundance of finfish and shellfish resources on the one hand, and between waterborne toxins and the distribution of such resources on the other hand. Second, analyses take place on the causes and effects of plankton blooms. Among these analyses are studies of the macronutrient and micronutrient requirements of dinoflagellates involved in red tides, fish kills, and other bloom-induced phenomena. The investigation monitors and describes such plankton blooms and associated physical and chemical factors to determine the impacts upon various marine resources. Third, the staff looks into oxygen utilization by sediments and waters polluted with such organic materials as sewage sludge, dredging spoil, and petroleum. The uptake rates are correlated with temporal and spatial distributions and standing stocks of benthic, demersal, and pelagic organisms. And fourth, the investigation determines the cell numbers and identities of significant aerobic bacteria in the Mid-Atlantic Bight. Such determinations qualitatively document the health of this ecosystem and reveal the functions of microorganisms in the marine environment. The metabolic rates of this heterotrophic activity are compared, particularly on a long-term basis, with the presence of various organic contaminants and the occurrence of various environmental factors.

4.3 Physiological Effects of Pollutant Stress Investigation

This investigation determines how and to what degree pollutants, individually and in combination, affect various marine animals at different life stages. New laboratory rearing techniques permit studies of pollutant effects upon embryonic, larval, and juvenile stages, as well as upon the adult stage which has been the focus of most past research.

The gradual reduction or elimination of a species by sublethal levels of pollutants is no less serious than the demise caused by lethal levels. Possibly it is more serious, since sublethal effects are less likely to be detected and traced to their source before irreparable damage has occurred. The decreased productivity of fish stocks due to sublethal pollutant exposures that impair growth, reproduction, and survival is a principal concern of this investigation.

These effects are slow and do not cause immediately obvious changes in populations, but cause subtle alterations in physiological functions and behavior that affect migration patterns, responses to temperature change, egg viability, and/or growth rates. The results are slow changes in reproductive rates and population sizes. Because chemical contaminants occur in the marine environment at higher concentrations than those that have been shown to cause adverse effects in the laboratory, it is probable that these pollutants are now adversely affecting the productivity of important fish, shellfish, and crustacean populations.

Accordingly, staff members research the physiology and biochemistry of selected species of marine animals common to the Mid-Atlantic Bight and other Northwest and Middle Atlantic environments, and determine experimentally the effects of heavy metals on their survival, development, and normal life functions. They have established tolerance ranges and the sublethal concentrations at which metabolic disturbances can be detected in embryonic, larval, juvenile, and adult stages of mollusks, crustaceans, and finfish, particularly those of commercial, recreational, and ecological importance. Biological models may be useful in future evaluations of pollutant-related stresses in marine environments, and this investigation will provide the necessary input for these models.

This investigation is also concerned with those microorganisms capable of growing under reduced oxygen tension (anaerobic conditions) in the fisheries environment and on living marine resources. The major goal is to determine the presence of pollutant and disease-producing anaerobes in the fisheries environment, their persistence and cycling through the food chain, and other possible interrelated toxin transfer mechanisms and chemical conversion mechanisms which can adversely affect fish stocks and their habitats.

4.4 Behavior of Marine Fishes and Invertebrates Investigation

To define the physical, chemical, and biological requirements of marine fishes, this investigation studies species behavior and ecology in both the field and laboratory. Research concerns the role of various environmental factors in the life habits of selected species, how man-made and natural modifications of the environment affect those life habits, and the capabilities of species to detect and avoid potentially lethal conditions. Field studies focus on feeding habits, habitat requirements, relationships with different substrates, seasonal patterns of activity, distributions, and interspecific and intraspecific relationships of such inshore demersal species as tautog, cunner, and winter flounder. These studies help to define life habits and environmental requirements of various life stages of each species. Laboratory researchers record normal activity, feeding, and social behavior (aggression, territoriality, and reproduction) in such species as adult tautog, cunner, red hake, juvenile bluefish, and other finfish, as well as physicosensory and chemosensory responses in such brachyuran crustaceans as blue crabs. Data from this research define the effects of environmental conditions and stresses on life habits, recruitment, and survival. Another task pools previous research findings on normal behavior to gauge the effects of selected environmental stresses on schooling, feeding, and activity in juvenile striped mullet and bluefish, and on territoriality, feeding, reproduction, and activity in adult tautog and brachyuran crustaceans.

4.5 Coastal Monitoring, Assessment, and Prediction Investigation

The Coastal Monitoring, Assessment, and Prediction (COMAP) Investigation routinely surveys the fish, plankton, and benthos of the inner coastal region (20-100 meters in depth) from Block Island Sound to the Bay of Fundy. Among other things, these monitoring surveys assess the impact of man's activities on the inshore environment and its organisms. Specifically, staff members make these assessments by noting changes in the distribution and relative abundance of fish and invertebrate species in response to changes in the physical and chemical environment. These environmental changes range from oil spills, to thermal pollution, to disposal of dredging spoils. Investigators also collect data on recruitment mechanisms for such commercially important species as American lobster, Atlantic herring, Atlantic mackerel, and winter flounder. They also assess the inshore distribution and relative abundance of species sampled semiannually in NEFC offshore bottom trawl surveys.

A significant and increasing portion of COMAP activities involves serving as an NEFC liaison to individuals and groups (such as the New England Fisheries Development Program) with diverse interests in inshore waters. COMAP cooperates with outside scientists in assessing fish stocks off the Northeast and Middle Atlantic States, and reviews research proposals by the private sector for siting and impact studies for power plants, dredging spoil disposal areas, and other operations that could potentially adversely affect fish stocks and other renewable marine resources.

4.6 Coastal Ecosystems Investigation

The major objective of this investigation is to collect baseline geological, physical, chemical, and biological data to assess changes in benthic and demersal populations in Long Island Sound, Gulf of Maine, and Mid-Atlantic Bight estuaries and coastal zones. The program is integrated among state, interstate, and other federal research organizations. In the estuarine research, the investigation emphasizes population studies. Long Island and

Block Island Sounds, Raritan and Delaware Bays, and numerous smaller embayments of the Mid-Atlantic Bight are the primary study areas. The investigational staff works on the interrelationships between various benthic and demersal species that live all or part of their lives in the estuaries. The staff also models the pollutant pathways from contaminated embayments to coastal zones.

In the separate but related research on coastal zones, the investigation studies those offshore populations in the Mid-Atlantic Bight that are affected by ocean disposal of sewage sludge, dredging spoils, and industrial wastes; by energy development; and riverine runoff from the Hudson and Delaware Rivers. This population information helps to document the causes and effects of extensive coastal anoxic conditions. The investigation also compiles data on contamination of Northwest and Middle Atlantic waters by various bordering states, and provides this information to various international organizations involved with the fisheries resources and water quality of the area.

5. AQUACULTURE DIVISION

The effects of nutrition, pollutants, and genetic processes upon growth and survival of commercially important marine species are the research responsibility of this Division. Studies concern the algal food nutrition, genetic selection, and disease and predator control associated with larval molluscan culture.

5.1 Spawning and Rearing of Mollusks Investigation

Oyster culture methods are adapted for the hatchery cultivation of other commercially important bivalves. This research and development program progresses logically from gametogenesis, through spawning the adults, rearing the larvae and growing the post-set stage immediately after metamorphosis, to growing the juveniles. The bay scallop and surf clam are currently being studied because of their potential for aquaculture.

5.2 Aspects of Nutritional Requirements of Mollusks Investigation

A priority of the research into commercial aquaculture methods is the development of an economical and nutritional supplement to the diets of animals in an aquacultural program. The investigation contributes to that cause by: (1) assisting in problem solving; (2) introducing innovative procedures; (3) studying phytoplankton food-chain organisms; and (4) researching molluscan food utilization. Another task is the support of all the molluscan research projects by providing a high quality and large quantity of algal food.

5.3 Aquacultural Genetics Investigation

This investigation develops genetic information to answer the questions of industry on how to develop profitable strains of hatchery shellfish. The investigation also advises industry on various aspects of aquacultural breeding without specific requests. A major goal of the program in aquacultural genetics is the creation of special gene pools at NMFS laboratories or under NMFS auspices. Industry and consumers would benefit from the improved management of wild shellfish beds that would result from the increased knowledge of the genetic potentials of wild shellfish populations based on studies of the special gene pools.

5.4 Control of Molluscan Disease Investigation

This investigation's work is an integral part of the NEFC's research on shellfish aquaculture. However, by the nature of the scientific expertise needed to conduct the investigation's research activities, the research is supervised by the Pathobiology Division. Thus, two Divisions are directly involved in this investigation.

Molluscan disease research focuses on the prevention, diagnosis, and control of disease, particularly in hatcheries and nurseries. Objectives are to: (1) monitor, isolate, identify, and culture micropathogens, and characterize their pathologic effects; (2) determine mechanisms of micropathogen transmission, penetration, infectivity, and host specificity; (3) study qualitatively and quantitatively micropathogen activity and host responses; and (4) evaluate the use of various chemicals including ozone gas to deactivate biotoxins and control micropathogens. A primary use of these methods is in the study of diseases of larval mollusks. The investigation seeks to develop physical methods, including ionization, to eliminate microbial pathogens and toxins in larval mollusks. The investigators on this project also provide consultation to industry and Sea Grant institutions involved in aquaculture.

6. PATHOBIOLOGY DIVISION

The Division works with all aspects of diseases, infectio us and noninfectious, biotic and nonbiotic, that affect marine resources. Not only is there an emphasis on the impacts of diseases on marine populations, but also on the influence of natural and man-made environmental factors on the occurrence of those diseases.

6.1 Disease and Environmental Stress Investigation

Disease, environmental changes, and pollutant stress act synergistically with those factors that induce death in marine poikilotherms. For this reason the investigation studies the pathologic effects on marine organisms caused by natural and man-made changes to marine ecosystems. Such man-made changes include habitat modification by ocean waste disposal, dredging activities, recreational activities, and petroleum development. Field and laboratory research establishes the causes of death, abnormality, and tissue and cellular pathosis (anatomical, physiological, and biochemical) in the affected marine organisms. The investigation concentrates on five specific research topics to achieve these goals. First, fin rot disease is studied in the New York Bight. Researchers try to determine the prevalence and pathogenesis of fin rot in winter and summer flounders in the Bight. Trawl surveys and entrapment studies provide the diseased specimens for histopathological examination. Second, immunity in marine fishes is researched. The two principal goals of this study are to determine whether pollution reduces the immunity of fishes to bacterial disease, and to correlate fish diseases with raised levels of serum antibodies for specific bacteria in the fishes. The study operates through examination of antibody responses and cellular defenses of fishes in both the field and the laboratory. A variety of immunological and cytochemical tests analyze systems of fish immunity under the combined stress of pollutants and bacteria. Third, the microstructure of normal and physiologically stressed crabs, fish, and mollusks is studied. Normal and pathologic tissues of such species as blue crabs, winter flounder, striped bass, and Atlantic mackerel are studied by electron microscopy. In addition to examining organisms with naturally occurring diseases, the staff also conducts experiments on new pathological and immunological procedures. Fourth, the investigation catalogues, maintains, and provides curatorial and custodial services for a permanent National Registry of Marine Pathology. This registry contains type specimens, photographs, and published literature on pathology in marine and estuarine poikilotherms. Additions to the registry are gathered by solicitation of the scientific community. Materials are available for study by qualified scientific and technical workers. And fifth, diseases of commercially and recreationally important fish species are studied histologically. The first objective of this research is to determine the causes of mortality in various fishes. The second objective is to analyze the lethal and sublethal effects of introduced chemical contaminants upon various species and life stages of fish.

6.2 Comparative Pathobiology Investigation

Infectious and noninfectious diseases limit the abundance, distribution, and utilization of marine organisms. Therefore, a knowledge of the causes and effects of these diseases is fundamental for successful management of fisheries resources and habitats. In this investigation, normal and abnormal organs, tissues, and cells are intensively observed for comparative histology, cytology, and epizootiology. Light and electron microscopy reveal pathologic conditions induced experimentally, occurring naturally, or found in aquacultural processes. Micropathogen activities are defined and described quantitatively and qualitatively and infectious agents and microparasites are identified and characterized.

To achieve these goals one of the first steps is to study the health status of mollusks, crustaceans, and fish. For mollusks, the investigation studies the microstructure of tumors, describes the morphology and cytopathology of oyster viruses with light and electron microscopy, and describes the microparasites of domestic and exotic species. For crustaceans, most of the effort is on blue crabs, rock crabs, and shrimp. Research on the crabs involves: (1) the study of the epidemiology of viral infections; (2) the study of the transmission mechanisms of protozoan viruses, and of such protozoa as Paramoeba; and (3) the preparation of an atlas of blue crab histology. With respect to shrimp, other crabs, and lobsters, the staff concentrates on the pathobiology of the exoskeleton and gills.

Another area of study within the investigation concerns the microfauna associated with fish, crustaceans, and mollusks. Staff members isolate and identify the protozoa of both the water column and sediments of the New York Bight, identify gill-fouling organisms of New York Bight crustaceans by microscopic examination of stained gill sections, and determine the prevalence of sporozoan parasites in the blood tissues of Atlantic mackerel and of other parasites in other fish.

6.3 Health of Ocean Finfish and Shellfish Investigation

The integrity of oceanic ecosystems is directly reflected in the health and well-being of their inhabitants. Except in the most unusual circumstances, the presence of healthy animals signifies a healthy encironment and vice versa. Thus, the purpose of this investigation is to assess comparatively the health of several selected target species of ocean fish, crustaceans, and mollusks from selected ocean sites.

The presence and abundance of infectious microorganisms (viruses, bacteria, and protozoa), some of which also produce highly toxic substances, are magnified in unbalanced ecosystems. These organisms can cause disease and abnormalities among resident species either directly or indirectly as secondary invaders acting in concert with other environmental stresses. Similarly, the health of ocean species can be profoundly affected by man-introduced noninfectious agents, such as petroleum and its byproducts, various agricultural and industrial pollutants, and substances leached from dredged materials.

Approaches used to ascertain the health of target species will include: (1) studies of fish immune systems to determine if the animals produce the necessary defense mechanisms to combat or overcome disease (that is, these mechanisms operate normally and how they are affected by natural and man-induced stresses); (2) observations on the prevalence of gross and microscopic lesions and descriptions of same on the tissue, cellular, and subcellular levels, using light and electron microscopy; (3) cytochemical and clinical chemical analyses of cellular and humoral responses to infectious and noninfectious diseases; and (4) use of microbial and cellular systems (bacteria, fungi, and animal cell lines) for mutagenic and carcinogenic assays and for indicators of pollution (viruses, bacteria, and protozoa).

7. MANNED UNDERSEA RESEARCH AND TECHNOLOGY PROGRAM

The Manned Undersea Research and Technology (MURT) Program functions as both an autonomous and support research group. MURT deals with sampling needs and ecological studies that are difficult, costly, or impossible with conventional surface research vessels. MURT's dive team works to: (1) develop an efficient research diving capability to and beyond the edge of the Continental Shelf with conventional and advanced diving technology and research submersibles; (2) survey the macrobenthos of the outer Continental Shelf; (3) study *in situ* the early life stages of Atlantic herring and the ecological factors affecting their eggs and larvae; (4) define the sampling efficiency of standard surface-oriented sampling hardware; and (5) monitor the abundance and ecology of bottom-oriented fauna and flora at specific locations on the New England Continental Shelf as an index to ocean health.

8. NATIONAL SYSTEMATICS LABORATORY

The National Systematics Laboratory is administered by the NEFC, but serves the entire Fisheries Service. It studies the systematics of commercially, recreationally, and ecologically important marine organisms. Included in these studies are projects on taxonomy to facilitate the identification of species, on anatomy to document species classifications, and on the characterization of biogeographic complexes. Emphasized are epipelagic, deep pelagic, and benthic fishes; peneid shrimps; and crabs and other decapods.

9. ATLANTIC ENVIRONMENTAL GROUP

The Atlantic Environmental Group (AEG) supports the research programs of the NEFC and other NOAA components operating in the Atlantic Ocean by monitoring and studying environmental conditions and by analyzing environmental data acquired from various governmental agencies, private and academic institutions, and archives. Analyses performed by the AEG include portrayal and interpretation of oceanic and atmospheric data for environmental and fisheries forecasting. The AEG also develops techniques, models, and indices for such forecasting. And, it advises NMFS's Office of Scientific and Technical Services, NOAA's Office of Marine Environmental Protection, and the National Ocean Survey's Ocean Dumping Research and Monitoring Office on marine environmental studies.

PROPOSED PROJECTS

In the event of an acute oil spill on the Continental Shelf, personnel, facilities and equipment of the Northeast Fisheries Center will be made available so that sampling programs and physiological analyses can be conducted in timely fashion at regular intervals to monitor the immediate effects of oil contamination.

The projects described in the following section will be carried out in addition to the ongoing long-term population monitoring and physiological studies of NEFC. Results of these projects will be compared against the long-term baseline data collected by the Center over the past fifteen years and an evaluation of the impact of acute oil spills on the marine ecosystem will be made.

PANEL: WATER COLUMN BIOLOBY
PROJECT NO: 4
PRIORITY RANK:

1. Project Title

Ichthyoplankton Survey - MARMAP Survey I

2. Project Description

Standard ichthyoplankton and neuston samples are taken during all Bottom Trawl Surveys - MARMAP II (Figure 2). The description of sampling methods and techniques is found in Appendix I - MARMAP I Survey. In addition to the three survey periods, special plankton cruises are bimonthly, often in cooperation with the USSR, Poland, FRG, GDR, and Canada. Ichthyoplankton and zooplankton are monitored for temporal and spatial variations in species abundance and succession. In the event of an oil spill particular attention will be focused on the impact of the oil to the food web and overall productivity of the marine ecosystem including larval fish and their zooplankton food.

3. Performing Organization

NMFS, NEFC Marine Ecosystem Division

4. Applicable Habitats

Continental Shelf waters including Georges Bank, Gulf of Maine, and the Mid-Atlantic Bight.

5. Applicable Conditions

Studies should be limited to major oil spills.

6. Applicable Oil Type

All types of spilled oil should be studied.

7. Time Frame

Sampling will be initiated as soon after an oil spill as possible. Additional monthly or bimonthly sampling would be conducted to ensure an adequate time series of samples.

8. Cost

Sorting, volumizing and identifying major taxa $200/sample @3 samples/station (neuston, 0.505 ichthyoplankton, 0.333 zooplankton) $600/station.

Assuming a minimum of 10 stations in the vicinity of a spill (30 samples) for each of 3 months (30 X 3 = 90 samples)	$54K
Analyzing data, preparing reports	5K
Total	$59K

Hydrocarbon analyses of zooplankton samples is an additional $1400/sample - see Hydrocarbon Analyses project.

9. Equipment Needs/Equipment Available

Standard MARMAP I sampling equipment

10. Facility Needs/Facilities Available

NMFS, NEFC, Polish Sorting Center, Szczecin, Poland

11. Personnel Needs/Personnel Available

NMFS, NEFC, Polish Sorting Center, Szczecin, Poland

12. Support Services

Several Investigations within the Marine Ecosystem Division are involved with collecting and analyzing ichthyoplankton data. In addition the Ichthyoplankton Survey "piggybacks" on all groundfish survey cruises.

13. Payoffs

The MARMAP ichthyoplankton survey serves as a baseline against which we will measure changes in species abundance, composition and succession that might be caused by a major oil spill.

14. Limitations

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 5
PRIORITY RANK:

1. Project Title

Bottom Trawl Survey Operations - MARMAP Survey II

2. Project Description

Investigate variations in the abundance and species composition in the oil spill area. Compare variations in stock abundance with the same area for other seasons and other years. Conduct Survey Operations at least three times a year and initiate special cruises at the time of the spill and monthly or bimonthly thereafter in order to provide an adequate time series of samples. Collect fish and invertebrates for genetics, physiology, biochemistry, and pathology investigations listed in the following fishery projects.

3. Performing Organizations

NMFS-NEFC Bottom Trawl Survey Operations NEC-004. Woods Hole, Mass.

4. Applicable Habitats

Continental Shelf waters including the Gulf of Maine, Georges Bank, and the Mid-Atlantic Bight. Figure 2 illustrates the Survey Operations coverage three times a year.

5. Applicable Conditions

Any major oil spill.

6. Applicable Oil Type

All types of oil should be studied.

7. Time Frame

Sampling will be initiated as soon after an oil spill as possible. Thereafter a minimum of three surveys a year would be made of groundfish in the oil spill area. Special monthly or bimonthly cruises would be initiated to augment spatial and temporal sampling in the vicinity of the oil spill.

8. Cost

NEFC annual support for Survey operations is $462.8K. Additional funds would be required in the event of an oil spill. Three special cruises at $5K/day for:

10 days would be	$150K
Data analyses	50K
Total	$200K

9. Equipment Needs/Equipment Available

See MARMAP II Survey Operations and Appendix II

10. Facility Needs/Facilities Available

NMFS, NEFC

11. Personnel Needs/Personnel Available

NMFS, NEFC

12. Support Services

Each fall, spring, and summer the Resource Surveys Investigation surveys with bottom trawls the fisheries resources of the Continental shelf from Nova Scotia to North Carolina (Figure 2). These surveys are part of the marine Monitoring, Assessment, and Prediction (MARMAP) Program's Survey II effort to document the relative abundance and distribution of these resources in the area. Supplementary surveys of the area occur regularly, many as cooperative efforts with other nations that fish in the Northwest Atlantic (Figure 1). These supplementary surveys often gather information that is not gathered in the semiannual surveys such as the seasonal/areal distribution of surf clams and the tagging of fish for stock estimates and migration studies.

The standard data that are recorded on these various surveys are the length, weight, age and maturity of the fish, and the temperature and depth of the water where captured. Ichthyoplankton samples and other hydrographic data are also often collected. Such data reveal changes in the size, composition or structure of the fisheries resource.

The role of the Resource Assessment Division of which the Survey Operations is a part, is to assess the effects of harvesting on fisheries resources. To do this assessment, the Division estimates the relative and absolute abundances, spatial and temporal distributions, and harvestable numbers, sizes, and weights of finfish, shellfish, and crustaceans in the Northwest Atlantic; and determines the productivity of these renewable marine resources from an ecosystem standpoint. To accomplish these tasks, the Division analyzes both domestic and foreign data from commercial fisheries, recreational fisheries, and research surveys. Additional economic and biological studies provide data for modeling the fisheries to aid in their management for optimum sustainable yield.

13. Payoff

The NMFS has developed fisheries independent methods for monitoring changes in fisheries abundance and distribution. In addition to survey data, it uses fishermen interviews, age and growth studies, cohort analyses, as well as commercial and recreational catch data to assess fish stocks. With this information multispecies yield models are developed. By monitoring temporal and spatial variations in fish populations over long periods of time it is possible to separate the complex influence of naturally occurring variation from variations caused by pollution such as oil.

14. Limitations

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 6
PRIORITY RANK:

1. Project Title

Demersal Food Chain Investigations

2. Project Description

During Survey Operations stomachs will be excised from key predator species. Stomachs will be labeled with date, station, cruise, species, length, sex, and maturity, and preserved in 10% formalin. Laboratory examination of the stomach contents will reveal volume of food, species composition of prey items, presence or absence of oil. If oil is present the sample will be designated for hydrocarbon analysis.

3. Performing Organization

NMFS-NEFC Benthic Dynamics and Demersal Food Chain Studies
NEC-016. Woods Hole, Mass.

4. Habitats Applicable

Continental Shelf waters including Georges Bank, Gulf of Maine and the Mid-Atlantic Bight.

5. Conditions Applicable

Studies should be limited to major oil spills.

6. Applicable Oil Types

All types of oil spills should be studied.

7. Time Frame

Sampling should be initiated as soon after an oil spill as possible. Additional special sampling should continue on a monthly or bimonthly basis until no oil attributable to the spill is detected in the stomach/food chain.

8. Cost

Annual NEFC support is $176.1K. Special sampling in the event of an oil spill would cost $4.9K per 10-day sampling cruise, assuming three such cruises, the additional cost would be $14.6K plus $2K for data processing.

9. Equipment Needs, Equipment Available

Equipment needed for sampling stomachs is scissors, labels, gauze, jars, formalin, ties. These are provided by the Food Chain Investigations projects. Additional equipment necessary for stomach analyses is available within the project.

10. Facility Needs/Facilities Available

NMFS, NEFC

11. Personnel Needs/Personnel Available

NMFS, NEFC

12. Support Services

The Survey Operations project collects the samples routinely and would collect additional special samples in the event of an oil spill. If oil is detected in the stomach, the sample would be contracted to NMFS Analytical Laboratory, Seattle, Washington; the Univ. of Rhode Island, Kingston, RI, or some other organization for a detailed hydrocarbon analysis.

13. Payoff

The Demersal Food Chain Investigation is continuing a systematic examination of stomachs, to date over 30,000 have been examined. This provides a baseline of what is expected to be present in a demersal food web. After an oil spill this investigation can provide reports on the potential impact on fish stocks in terms of hydrocarbons in the benthis food web.

14. Limitations

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 7
PRIORITY RANK:

1. Project Title

Physiological and Biochemical Effects of an Oil Spill on Selected Fish and Shellfish

2. Project Description

Selected tissues and blood samples will be taken and analyzed for biochemical shifts in activity and ion balance. Oxygen consumption rates will be determined. Initial studies will be conducted for two purposes: (1) selection of those animals and tissues that can be successfully prepared, packaged and stored frozen for transport to a shore laboratory without significant change in physiological character or biochemical activity, and (2) exploratory biochemistry to discover metabolic "yardsticks" that are both analytically feasible and environmentally significant. Sampling protocol is listed in Appendix IV.

3. Performing Organizations

NMFS, NEFC Physiological Effects of Pollutant Stress NEC-037.
Milford, Conn.

4. Applicable Habitats

Continental Shelf waters including Georges Bank, Gulf of Maine, and the Mid-Atlantic Bight.

5. Applicable Conditions

Studies should be limited to major oil spills.

6. Applicable Oil Type

All types of oil spills should be studied.

7. Time Frame

Sampling will be initiated as soon after an oil spill as possible. Additional monthly or bimonthly sampling would be conducted until results indicate a return to "baseline" or control conditions.

8. Cost

NEFC annual support is $261K. In order to study the effects of an oil spill these funds will need to be augmented by an additional $20K, the cost of analyzing samples collected on three 10-day cruises.

9. Equipment Needs/Equipment Available

Equipment for collection of samples is found on all NMFS vessels. Laboratory equipment, chemicals, glassware is available at the NOAA-NMFS Milford, Conn. Laboratory.

10. Facility Needs/Facilities Available

NMFS, NEFC

11. Personnel Needs/Personnel Available

NMFS, NEFC

12. Support Services

Notification would be required so that special instructions or personnel could be available for oil spill sampling cruises and standard survey cruises.

13. Payoff

The purpose of this project is to monitor the physiological condition of key populations and to determine rates of recovery to more normal conditions following an oil spill. It will establish metabolic norms for indicator animals and will select key parameters for detecting stress in these animals thus providing a model for monitoring the health of our living marine resources.

14. Limitations

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 8
PRIORITY RANK:

1. Project Title

Histopathologic Effects of an Oil Spill on Marine Organisms

2. Project Description

Morphologic study of cells and tissues from oil exposed and control animals will be studied via the light and electron microscopes. Histochemical methods will also be utilized to determine any chemical changes which may be taking place in the cells and tissues. Utilization of these tools should give us some indication as to whether or not any tissue changes are taking place in the exposed animals. Comparison of cells and tissues of the control animals using the same methods and baseline data will give us some indication as to whether or not these changes are due to the oil.

The methods and techniques employed are the same as those used by animal (experimental), and human pathologists during the past 50-100 years.

3. Performing Organizations

NMFS, NEFC Disease and Environmental Stress, Life Studies Comparative Pathobiology NEC-038, 039. Oxford, Md.

4. Applicable Habitats

Continental Shelf waters including the Gulf of Maine, Georges Bank and the Mid-Atlantic Bight.

5. Applicable Conditions

Studies should be limited to major oil spills which have impacted large populations and organisms which can be identified by location.

6. Applicable Oil Type

All types of oil spills should be studied.

7. Time Frame

Sampling will be initiated as soon as possible after an oil spill and continued at regular intervals until no further effect which could be attributable to oil is detected.

8. Cost

Slide preparation and histopathologic analysis of the slide runs anywhere from $12.00 to $15.00/slide. It will cost $12K per species for a 2-year study, $5K/species for a 6-month study.

Travel and preparation of reports - $50K.

9. Equipment Needs/Equipment Available

A field model kit containing fixatives, alcohol for storage of specimens, bags, shucking knives, etc. has been constructed by the Histopathology Unit of ERL-N. Some improvements will be made and it is hoped that these kits will then be made available for histopathologists who respond to oil spills.

A manual for the preparation of aquatic animals for histopathologic examination has been prepared by the Histopathology Unit of ERL-N and will be distributed throughout the country to interested people.

A histopathologic technique manual prepared by the Pathology Branch of the NMFS, NEFC Laboratory, Oxford, Md., will soon be available to interested people.

Necessary equipment for the preparation and analysis of microscopic slides is available at NMFS, NEFC.

10. Facility Needs/Facilities Available

NMFS, NEFC

11. Personnel Needs/Personnel Available

NMFS, NEFC and contractors

12. Support Services

In order for this project to function properly the histopathologist should be informed as to the possible oil spill impact, etc. by the on-scene coordinator. Also close coordination should be maintained with the analytical chemists who will be doing hydrocarbon determinations of the animals. In fact, when specimens are collected, they should be collected from the same time, area, species, etc. as those collected for the analytical chemists.

13. Payoff

Very little is known about the histopathologic effects of oil on marine populations. Long-term observations of animals exposed to oil would provide information about effects and recovery rates. Studies must be correlated with laboratory toxicity experiments in order to evaluate the impact of oil on marine populations.

14. Limitations

Histopathology would be of use only on animals which have come into contact with the oil in some form or manner. Results of field studies can be evaluated only if there are also controlled laboratory studies to provide baseline information.

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 9
PRIORITY RANK:

1. Project Title

Hydrocarbon Analyses of Fish, Shellfish, Zooplankton

2. Project Description

Selected tissue samples of fish, stomachs suspected of containing oil, and zooplankton samples from selected stations will be analyzed for petroleum hydrocarbons. Samples will be collected by survey cruises and other special cruises. A time-series of samples will be established starting with those collected immediately after the cruise and thereafter at regular intervals for a year or until no hydrocarbons attributable to a particular spill are detected.

3. Performing Organization

NMFS, NEFC will be responsible for collecting the samples on Survey and special cruises. Samples designated for hydrocarbon analyses will be contracted to NMFS National Analytical Laboratory, Seattle, Washington; University of Rhode Island, Kingston, R. I.; or some other institution.

4. Applicable Habitats

Continental Shelf waters including Gulf of Maine, Georges Bank and the Mid-Atlantic Bight.

5. Applicable Conditions

Any major oil spill.

6. Applicable Oil Type

All types of oil should be studied.

7. Time Frame

Samples will be collected immediately following an oil spill and thereafter monthly until analyses indicate no detectable amount of the spilled oil in tissues or food chain components.

8. Cost

The cost of tissue analysis is $700 (NMFS, Seattle, Washington) and the cost of analyzing plankton is $1400.

Assuming 20 tissue samples/month for
the first three months: 14,000 x 3 = $42K

Plankton 4 samples/month for
the first three months: 5,600 x 3 = $16.8K

Total $58.8K

9. Equipment Needs/Equipment Available

Necessary equipment for collection and storage of samples is available on Survey and special cruises. Equipment necessary for analyses would be the responsibility of the contractor.

10. Facility Needs/Facilities Available

NMFS, NEFC; NMFS National Analytical Laboratory, Seattle, Washington or other

11. Personnel Needs/Personnel Available

NMFS, NEFC; NMFS National Analytical Laboratory, Seattle, Washington, or other

12. Support Services

In order for this project to function properly, one individual must act as coordinator to select fish and shellfish samples for analyses as well as plankton samples. Food chain investigation people must also be informed of the procedure to follow if oil is found in the stomach of any fish. The coordinator should maintain good communications with the analytical chemists doing the hydrocarbon analyses.

13. Payoff

The results of these studies will indicate the fate of petroleum hydrocarbon in the food chain. It will also give results concerning the possible tainting of marine resources which would affect their use for human consumption. The time series will also provide information on the persistence of oil in the environment after a major spill.

14. Limitations

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 10
PRIORITY RANK:

1. Project Title

The Genetic Effects of an Oil Spill on Developing Fish Embryos

2. Project Description

Preserved eggs from plankton and neuston tows will be sorted by species and stage. They can then be examined for genetic damage. Using the methods of Longwell (1976) the extent (%) of damage can be estimated, i.e., morbidity, moribundity, abnormal embryos, chromosome damage, for that sample. The results can be compared for samples from clean and impacted areas and for historical data.

3. Performing Organization

NMFS, NEFC Cytology, Cytogenetics, Embryology and Development of Fish Eggs. Field and Laboratory NEC-089. Milford, Conn.

4. Applicable Habitats

Continental Shelf waters including Gulf of Maine, Georges Bank and Mid-Atlantic Bight.

5. Applicable Conditions

Any major oil spill.

6. Applicable Oil Type

All types of oil should be studied.

7. Time Frame

Samples will be collected immediately following an oil spill and at regular intervals thereafter until water column analyses indicate control levels of hydrocarbons in the water.

8. Cost

NEFC support annually is $195K. In order to study the effects of an oil spill these funds will need to be augmented by an additional $16.2K, the cost of analyzing samples collected on three 10-day cruises.

9. Equipment Needs/Equipment Available

Samples would be collected using standard MARMAP I Survey equipment. Equipment necessary for sorting samples and analyzing them cytogenetically is available within the Cytology Investigation.

10. Facility Needs/Facilities Available

NMFS, NEFC

11. Personnel Needs/Personnel Available

NMFS, NEFC

12. Support Services

The Survey Operations and Ichthyoplankton Investigations would be in charge of sampling and allocating subsamples for experimental examinations.

13. Payoff

Experimental and field studies have shown developing embryos to be particularly susceptible to genetic damage when exposed to various classes of toxic substances including oil. Samples taken in the vicinity of the *Argo Merchant* spill showed high percentages of moribundity, morbidity, abnormal development and chromosome damage. Results of such genetic studies are good indicators of environmental stress and can be used to assess the impact on the success of ichthyoplankton in the area of an oil spill.

14. Limitations

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 11
PRIORITY RANK:

1. Project Title

Toxicity Studies: The Effects of Oil on Developing Fish Embryos and Larvae

2. Project Description

Toxicity studies can be carried out for both egg and larval stages. Laboratory produced embryos will be brought out to sea and exposed to water pumped from areas beneath the slick, at the periphery of the slick and in "clean" areas. Water samples will be collected and analyzed for petroleum hydrocarbons. Samples will also be collected for dissolved oxygen and salinity determinations. Embryos will be exposed at different stages of development, and subsamples will be preserved at regular intervals for later genetic studies. Observations of the developing embryos will be made including heartbeat, sinking (due to osmoregulation difficulties) respiration, yolk utilization. Similar studies will be conducted under laboratory conditions using known concentrations of fuel oil types (e.g., crude, nos. 6, 4, 2) and the water soluble fractions.

The same procedures, both field and laboratory (excepting genetics studies) can be carried out for larvae. When larvae are used, feeding initiation, feeding, swimming behavior, respiration, RNA/DNA ratios, protein synthesis, growth and yolk utilization can be used to determine the effects of hydrocarbons on the larvae. In addition, histopathological studies can be carried out on preserved specimens.

3. Performing Organization

NMFS, NEFC Physiology: North Atlantic Larval Fish NEC-012. Narragansett, R. I.

4. Applicable Habitats

Continental Shelf waters including the Gulf of Maine, Georges Bank, and the Mid-Atlantic Bight.

5. Applicable Conditions

Studies should be limited to major oil spills.

6. Applicable Oil Type

All types of oil should be studied.

7. Time Frame

Field studies should be initiated as soon after an oil spill as possible and continued until no effect is detectable on the developing embryos and larvae. Laboratory studies can be carried out at the discretion of the investigators.

8. Cost

The annual NEFC support is $154K. In the event of an oil spill these funds would have to be augmented by an additional $16K. This assumes that the field studies can be carried out using ship time that has already been accounted for in the Survey Operations project (i.e., $5K/day).

9. Equipment Needs/Equipment Available

Equipment is available in the Physiology project.

10. Facility Needs/Facilities Available

NMFS, NEFC

11. Personnel Needs/Personnel Available

NMFS, NEFC

12. Support Services

In addition to Survey Operations and special cruises arranged in the event of a major oil spill, the Cytology (NEC-089) and Disease and Environmental Stress (NEC-039) investigations would augment physiological studies carried out by this project.

13. Payoff

Results of in situ and laboratory toxicity studies would provide information on the impact of oil on fish embryos and larvae. Cytogenetic and histopathology studies on the exposed organisms could give further indication on the kind of damage that occurs.

14. Limitations

These studies would be limited by the availability of laboratory spawned eggs.

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 12
PRIORITY RANK:

1. Project Title

Phytoplankton and Other Microorganisms

2. Project Description

Changes in species composition and abundance will be determined by comparing them with baseline data already available. Health of the phytoplankton communities exposed to oil will be determined using chlorophyll-phaeophytin relationships. Successional elements will be followed. Primary productivity of impacted populations will be estimated and photosynthetically available radiation, nutrients and other hydrographic factors will be measured.

3. Performing Organization

NMFS, NEFC Biological Oceanography of Stressed Ecosystems NEC-036. Sandy Hook, N.J.

4. Applicable Habitats

Continental Shelf waters including Georges Bank, Gulf of Maine and the Mid-Atlantic Bight.

5. Applicable Conditions

Studies should be limited to major oil spills.

6. Applicable Oil Type

All types of oil spills should be studied.

7. Time Frame

Sampling will be initiated as soon after an oil spill as possible. Additional monthly or bimonthly sampling would be conducted until results indicate a return to "baseline" or control conditions.

8. Cost

NEFC annual support is $214.8K. In order to study the effects of an oil spill these funds will need to be augmented by an additional $17K, the cost of collecting and analyzing samples collected on three 10-day cruises.

9. Equipment Needs/Equipment Available

Equipment necessary to carry out this project is available at the Sandy Hook, N.J., laboratory and is part of standard equipment on all NMFS vessels.

10. Facility Needs/Facilities Available

NMFS, NEFC

11. Personnel Needs/Personnel Available

NMFS, NEFC

12. Support Services

Sampling would be carried out during Survey Cruises. All samples would be analyzed by the Investigation.

13. Payoff

Because the lower trophic levels produce and consume 90-95% of the biological energy which passes through the marine ecosystem and because they are the base of the marine food web all other marine organisms except certain bacteria are dependent upon them. They have short generation times (0.5-10 days) and rapid growth rates and consequently are sensitive and responsive to alterations in the marine ecosystem. As such they are good indicators of environmental stress.

14. Limitations

PANEL: WATER COLUMN BIOLOGY
PROJECT NO: 13
PRIORITY RANK:

1. Project Title

   Fishery Oceanography: Environmental Studies

2. Project Description

   Hydrographic and nutrient Investigations will be carried out in the area of an oil spill. Temperature, salinity, and dissolved oxygen structure of the area will be determined. Current meters will be deployed to determine surface and bottom circulation in the area of the spill.

3. Performing Organization

   NMFS, NEFC Fishery Oceanography: Environmental Studies NEC-008. Woods Hole, Mass.

4. Applicable Habitats

   Continental Shelf waters including Gulf of Maine, Georges Bank and Mid-Atlantic Bight.

5. Applicable Conditions

   Any major oil spill.

6. Applicable Oil Type

   All types of oil should be studied.

7. Time Frame

   Studies should be initiated as soon after an oil spill as possible. Additional sampling will continue on a monthly basis for at least three months.

8. Cost

   Annual NEFC support is $467K. The cost of augmenting these studies in the event of an oil spill assuming three 10-day cruises would be $39K.

9. Equipment Needs/Equipment Available

   Most of the equipment needed for sampling is available on NMFS vessels or within the Investigation.

10. Facility Needs/Facilities Available

    NMFS, NEFC

11. Personnel Needs/Personnel Available

NMFS, NEFC

12. Support Services

Fishery Oceanography sampling operations can be carried out on Survey Cruises. Additional information will be obtained from the National Weather Service (NWS).

13. Payoff

Knowledge of temperature, salinity, dissolved oxygen regime in the area of a spill as well as the surface and bottom currents based both on baseline data from previous years and from the time of a spill allows estimates of risk analyses. Predictions of impacts on fish stocks and the anticipated movement of the surface oil can be made.

14. Limitations

BUDGET

Fund Augmentation Needed by the NEFC in the Event of a Major Oil Spill*

Bottom Trawl Survey	200K
Demersal Food Chain Studies	16.6
Physiological-biochemical Effects	20
Histopathology (4 species--2 years)	48
Report	50
Hydrocarbon Analyses	58.8
Physiology-larvae	16**
Ichthyoplankton	59
Genetics	16.2
Fishery Oceanography	39
Biological Oceanography	17
Total	540.6K

*Assuming all sampling is completed on three 10-day cruises or already scheduled cruises.

**Estimate made assuming ship time on a scheduled special cruise; if ship time is scheduled the additional cost would be 5K/day.

SUMMARY

The projects proposed are those which would be conducted by NEFC in the event of a major oil spill in Continental Shelf waters from Nova Scotia to Cape Hatteras. They would be carried out within the background of MARMAP Survey I and II baseline data collected in the Northwest Atlantic over the last 15 years. Standard methods of collecting would be employed according to standardized operations of Survey I and II (Appendices I and II). At each collection site hydrographic conditions would be monitored also.

The Ocean Pulse program data provides a baseline of physiological measurements against which impact on the health of fish stocks can be monitored. The projects proposed within the NEFC Fisheries Plan are those which would be carried out in direct response to a major oil spill. However, in order to assess the impact of an oil spill on renewable marine resources, long-term experimental and monitoring studies must be conducted to determine what the chronic effect of hydrocarbons on the marine ecosystem are. Therefore, in addition to _in situ_ sampling and monitoring several projects are recommended which are long-term and experimental:

1. Behavior of fishes under environmental stress (NEC-033) NMFS, NEFC, Sandy Hook, NJ.

2. Physiology of North Atlantic larval fish (toxicity studies, _in situ_ and laboratory, selected species) (NEC-012) NMFS, NEFC, Narragansett, RI.

3. Physiological Effects of Pollutant Stress (toxicity studies, biochemical or physiological effects on adult fish and larval and adult invertebrates).

4. Disease and Environmental Stress (toxicity studies, histopathology, larval and adult fish and invertebrates) (NEC-038, 039) NMFS, NEFC, Oxford, MD.

APPENDIX I. MARMAP SURVEY I OPERATIONS

A high degree of uniformity and standardization in Survey I Operations is essential to achieve MARMAP objectives. It is recognized, however, that some latitude in details of technique or procedure is desirable or even necessary because of regional variations in ecosystem parameters such as biota distribution, abundance, diversity, and environment. This document specifies procedures to be followed in the at-sea collection and laboratory analysis of Survey I data. Its provisions will be met by all activities and organizational elements of the National Marine Fisheries Service (NMFS), and other organizations participating in MARMAP Survey I under sponsorship of NMFS. It also describes the techniques for collecting concurrent environmental data, and for the quality controlling of all data. It should be understood that not all of these operations may be conducted on every cruise and that additional MARMAP Operations (Survey II, and/or Fishery Oceanography) may be carried out.

The MARMAP Station

A MARMAP Station is defined as a location in the ocean where data are collected. It has, for all routine operations, one position but may involve a number of activities. Stations are numbered consecutively beginning with the first station of a cruise. Following precedents set at a number of NMFS laboratories, bathythermograph (BT) lowerings will be numbered separately; and between-station BTs will not be assigned station numbers.

The MARMAP Master Station Record (MSR) is the only log sheet which lists the station position. This is done deliberately to prevent the proliferation of divergent data. Following each cruise the MSRs will be used to produce an accepted list of station positions for the voyage. This list will be made promptly available to all who are to be involved with the analyses of the cruise data.

Zooplankton - The Bongo Sampler

The standard sampling gear for all MARMAP Ichthyoplankton (Survey I) Operations is the Bongo net (Posgay and Marak, In Press) (Figure I-1). It consists of two cylindrical mouth pieces, 61 cm in diameter, (the towing wire passes between the cylinders and is therefore not in the sampling path) inside of which are fastened flowmeters. To obtain flowmeter readings representative of the entire mouth the meter must not be closer to the wall than 6 times the wall thickness. The nets are of a cylinder-cone configuration, 3.6 m long. The mesh aperture of one net is 0.333 mm and of the other net 0.505 mm, and the ratios of their mouth areas to total netting aperture areas are 1:7.3 and 1:7.9, respectively. Cod ends are routinely folded and tied off in the manner of a fishing net cod end. However, cod end beakers or socks may be used if desired.

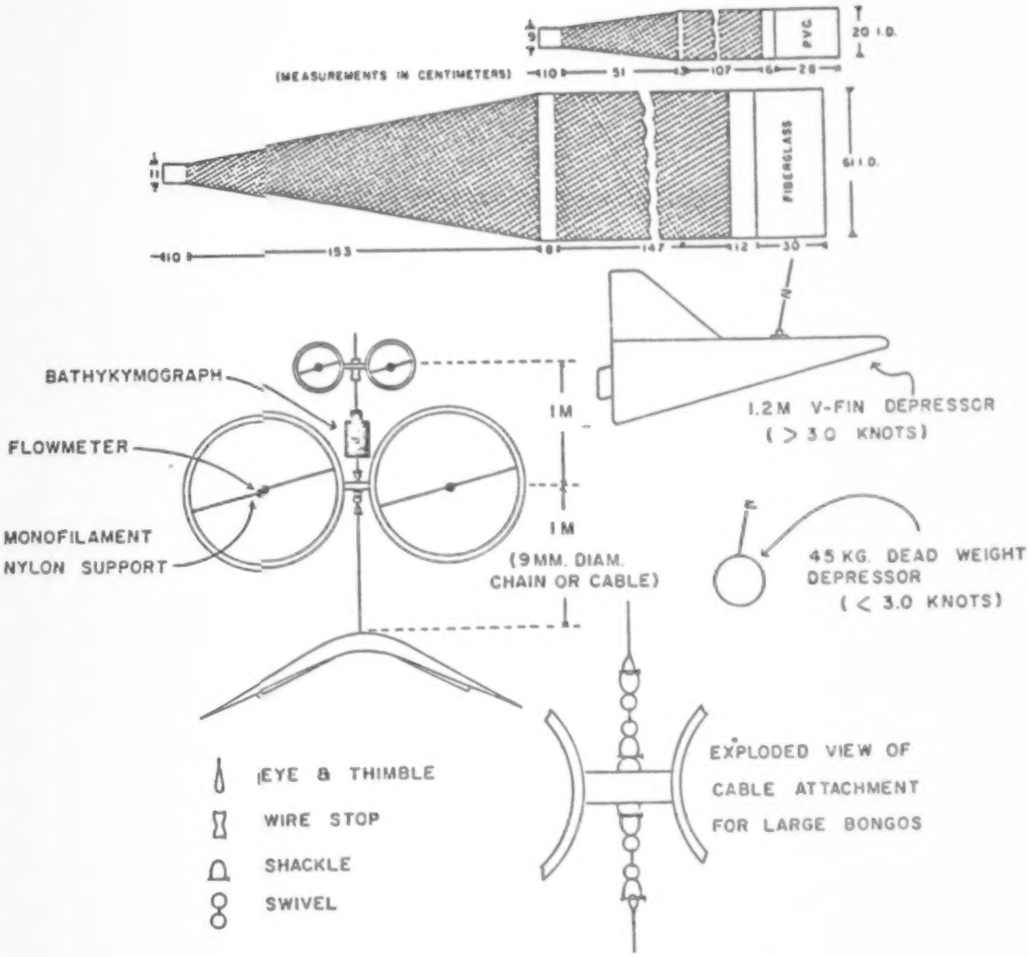
9
20 I.D.
PVC
(MEASUREMENTS IN CENTIMETERS)
10
51
3
107
6
28
11
FIBERGLASS
61 I.D.
10
153
8
147
12
30
BATHYKYMOGRAPH
FLOWMETER
MONOFILAMENT
NYLON SUPPORT
1 M
1 M
(9 MM. DIAM.
CHAIN OR CABLE)
1.2 M V-FIN DEPRESSOR
(> 3.0 KNOTS)
45 KG. DEAD WEIGHT
DEPRESSOR
(< 3.0 KNOTS)
EYE & THIMBLE
WIRE STOP
SHACKLE
SWIVEL
EXPLODED VIEW OF
CABLE ATTACHMENT
FOR LARGE BONGOS

Figure I-1. Arrangement of MARMAP Bongo Samplers on Tow Wire.
(From Posgay and Marak, In Press)

A depressing force is necessary to achieve desired results. At towing speeds of 1.5-2.0 knots a 45-kg dead weight depressor is sufficient. At speeds higher than 3 knots a 1.2-m V-fin depressor is necessary. Towing wire must be at least 6.4 mm (1/4 inch) diameter and of 300 m length plus that necessary for all rigging and a safe mount on the winch. Although tension during towing is about 250 kgm it can reach as high as 1,000 kg under dynamic loads. A Bendix Model T-1, or equivalent, time-depth recorder (to record tow profile) must be attached to the towing wire just above the attachment of the net. Each instrument must be calibrated at the beginning and end of its use.

For special studies the 20 cm mouth diameter Bongo sampler may be used in addition, or in place of, the 61-cm Bongos. If the 20-cm Bongo is to be substituted for the 61-cm Bongo during regular Survey I cruises, prior approval must be obtained from the MARMAP Program Office (MPO).

The standard tow for all MARMAP Ichthyoplankton (Survey I) Operations is the double oblique. This is a tow during which the sampler describes an oblique path and fishes during both descent and ascent. There should not be time spent at depth (horizontal sampling), and all depth strata should be sampled equally (i.e., the paths of descent and ascent should be straight lines).

The desired depth of the tow is to within 5 m of the bottom or to a maximum of 200 m. Figure I-2 shows the amount of wire out to achieve desired depths. Routine checks of time-depth records must be made and wire-outs to desired depth ratios adjusted accordingly.

Towing speed is between 1.5 and 2 knots. Higher speeds introduce variables, particularly extrusion, and make inclusion of the data with those from standard tows difficult. For those vessels without adequate speed control a valid tow may be achieved by monitoring wire angles during retrieval.

At the beginning of each tow both flowmeter readings are recorded ("Flowmeter start") to the nearest whole revolution. Care must be taken to prevent this reading from changing prior to the commencement of fishing, e.g., "windmilling."

NOTE: Flowmeters are calibrated at the beginning and end of each cruise. Calibration can be done at sea by towing the flowmeters, attached to a suitable frame, in two directions over a known distance. At least 2 tows in each direction at several towing speeds between 1.5 and 2.0 knots must be made. A calibration factor is calculated for the length of a column of water needed to affect one revolution of the meter (meters per revolution) at each towing speed. The units of the factor (meters per revolution) were chosen so that the factor would be applicable to nets of different mouth area for obtaining volume of water filtered: (Meter Revolutions)(Calibration Factor)(Mouth Area) = Volume Filtered.

When the ship is on course and steaming at 1.5-2.0 knots the Bongo array is launched. Start time for the tow is the time the flowmeter begins

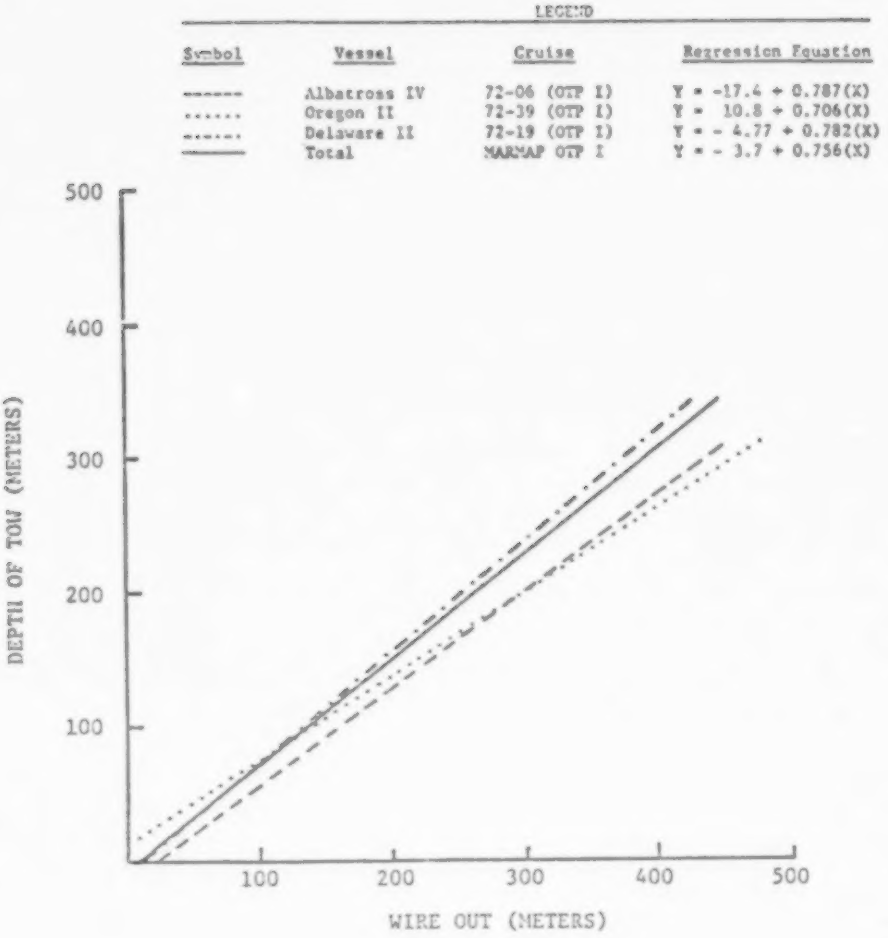

Figure I-2 Amounts of wire out to achieve desired depths for the MARMAP 61 cm bongo net.

These regressions imply a linear relationship between wire out and desired depth. In fact, the relationship is not linear over the entire depth range. Nevertheless, the curves are presented as an initial aid to workers attempting bongo tows, wire out will no doubt have to be adjusted based on the results of tows during any cruise. The curvilinear relation is under investigation and will be supplied as an amendment to this manual.

turning (note any "windmilling"). The towing wire is payed-out at a rate of 50 m/min. As soon as the necessary length is reached retrieval begins. Retrieval rate is 20 m/min. The ship should maintain a speed that keeps the tow wire closed to an angle of 47°. Wire angle is measured by an inclinometer which can be of the telemetering or non-telemetering type. If a telemetering inclinometer is used, the angle of stray can be controlled from the bridge. When a non-telemetering device is used an officer of the watch or the recorder observes the wire angles during the tow and signals the bridge if the desired angle is not being maintained. In both cases an observer on deck records wire angles for each 10 meters of wire during retrieval. Both the "time going out" and the "time coming in" (to the flowmeter's exit from water) are recorded. Standard tows result in zero "time at depth." Enter zero unless difficulties are encountered.

After getting the sampler aboard examine the TDR trace to determine its acceptability. If the trace does not fall in the envelope appropriate for its depth range the tow must be repeated.

Record the readings of both flowmeters ("Flowmeter end") and note any observed or suspected reasons for values to be in question (excess windmilling, damage, fouling of meter or apparent clogging of meshes of the net).

The nets are held off the deck by hand or by tackle and their contents are rinsed to their cod ends by a gentle spray of salt water directed from their outsides. The samples are then quantitatively transferred to appropriately labeled (for the 0.333 mm and 0.505 mm mesh apertures) buckets unless a cod end sock or beaker is used.

NOTE: The buckets often contain a great deal more water than is desirable to preserve. This may be eliminated by the use of a draining pan with meshes smaller than those of the collecting net. Also, on some occasions the sample may contain large quantities of jelly fish, salps, etc. They may be too large to fit into the sample jars provided. On such occasions separate these organisms, rinse any small, adhering organisms into the bucket containing the sample, log the large organism's description and estimated volume and discard them.

Quantitatively transfer the sample from the bucket to the draining pan. After the water has drained off, transfer the sample to a one quart sample jar(s) using a minimum of sea water from a rinse bottle directed at the back side (the mesh) of the pan. Use extra jars when necessary so that no jar is more than 1/2 full of suspended plankton or 1/4 full of drained organisms. Add sea water to about 3/4 full before introducing the preservative, to avoid "burning" the delicate specimens.

Add 50 ml of buffered concentrated formalin to each quart sample and top off with sea water.

NOTE: Preservative used for filling the original sample jars and in any subsequent sample container is 3-5% buffered formalin. (Formalin is a saturated aqueous solution of formaldehyde gas, about forty percent formaldehyde by weight.) The preferred buffer is marble chips. These are added to the formalin supply container, not the sample container, in a quantity to produce an excessive base. This results in sample containers receiving a preservative which is basic but which will not remain so indefinitely. Investigators working on samples containing delicate calcereous specimens may wish to alter the preservative they use.

Fill out and apply outside and inside jar labels which are preprinted and color coded for the gear and mesh used. Inside labels are written with waterproof ink (Higgins Engrossing Ink, No. 892, which does not clog the pen--Kohinoor Rapidograph No. 0 or 00--or equivalent). Outside labels, due to their oily surface texture, are written with ball point pen.

Fill out appropriate parts of the MSR and MARMAP Zooplankton Sample Logs (ZSL and ZSL-ADP).

Zooplankton - The Neuston Sampler

For neuston, near surface zooplankton, and contaminants such as tar and plastics the standard gear is the MARMAP neuston net (Figure I-3). It consists of a rectangular mouth constructed of 3.2 cm (1 1/4") ID standard wall aluminum pipe with opening dimensions of 0.5 m high by 1 m wide. The net is of conical configuration, 4.9 m long. The mesh aperture is 0.505 mm, and the ratio of mouth area to total netting aperture area is 1:7.8. Presently the cod end is being folded and tied-off similar to the Bongo net cod ends. A cod end sock or beaker may be used if desired. A simple bridle, most of which is out of the water during fishing, precedes the net mouth. Towing wire must be at least 0.6 cm (1/4") diameter steel and of 40 m length plus that necessary for all rigging and a safe amount on the winch. Wire or 1.3 cm (1/2") diameter nylon line may also be used on a warping capstan if a regular winch setup is not available. Tension during towing is about 250 kg but may reach 1,000 kg during dynamic loads.

The standard MARMAP tow is made with the net 1/2 submerged, and with a vessel speed of 2.0 knots for a duration of 10 minutes. In subtropical and tropical areas or for studies of species of relatively low abundance tows of longer duration may be made.

The vessel should be executing a slow turn in the same direction as the side of the ship from which the tow is being made. Tows made in the wake of the vessel are unsatisfactory. Also, any sanitary discharges which may contaminate the sample must be secured during the tow.

The start time for a neuston tow is taken when the net begins fishing 1/2 submerged. The end time is taken when the net exits the water.

The sample is quantitatively transferred from the net to a sample jar(s) in a manner similar to the Bongo samples.

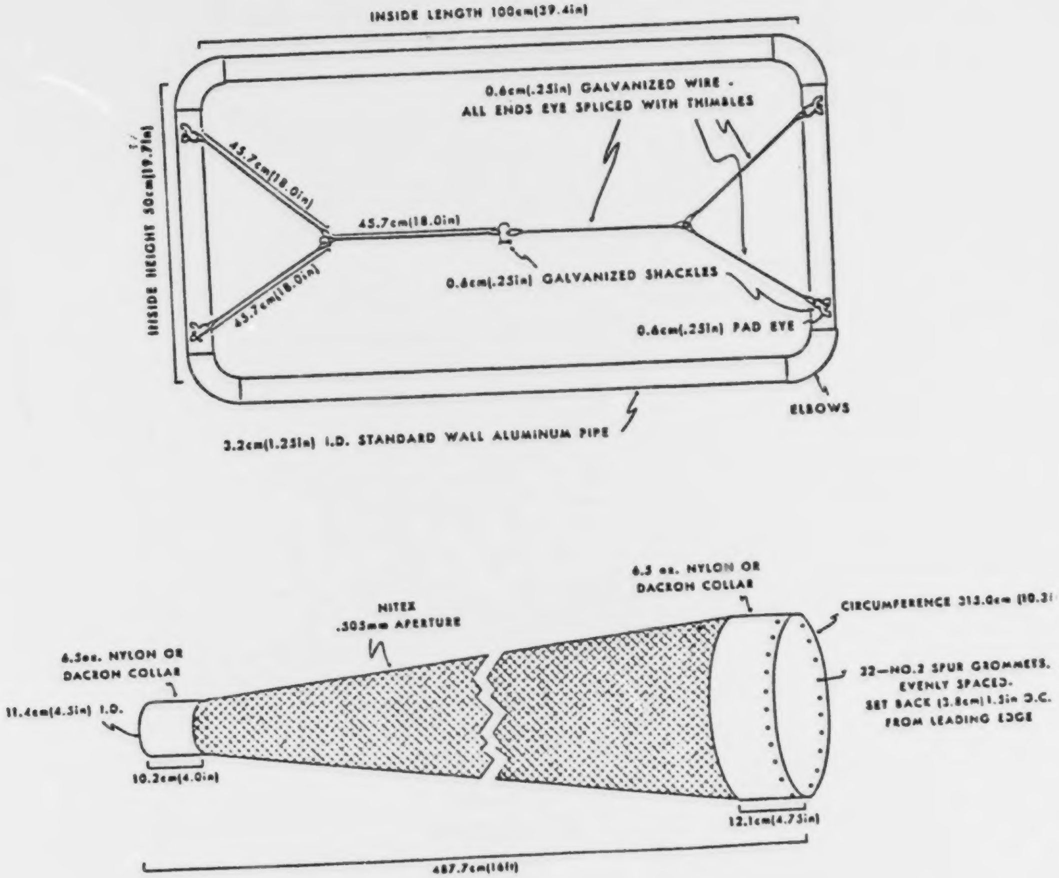
INSIDE LENGTH 100cm(39.4in)
INSIDE HEIGHT 50cm(19.7in)
0.6cm(.25in) GALVANIZED WIRE -
ALL ENDS EYE SPLICED WITH THIMBLES
45.7cm(18.0in)
45.7cm(18.0in)
45.7cm(18.0in)
0.6cm(.25in) GALVANIZED SHACKLES
0.6cm(.25in) PAD EYE
ELBOWS
3.2cm(1.25in) I.D. STANDARD WALL ALUMINUM PIPE
6.5 oz. NYLON OR
DACRON COLLAR
NITEX
.505mm APERTURE
CIRCUMFERENCE 313.0cm (10.3
6.5oz. NYLON OR
DACRON COLLAR
11.4cm(4.5in) I.D.
32—NO.2 SPUR GROMMETS.
EVENLY SPACED.
SET BACK (3.8cm) 1.5in O.C.
FROM LEADING EDGE
10.2cm(4.0in)
12.1cm(4.75in)
487.7cm(16ft)

Figure I-3. The MARMAP Neuston Sampler.

NOTE: Tar balls may be encountered. If possible preserve them with the rest of the sample. If, however, the tar balls are too large for the sample jars, place them in plastic bags with an inside "Biological Sample Label" and place the bags in a freezer.

Fill out and apply outside and inside jar labels which are preprinted and color coded for the gear and mesh used.

Fill out appropriate parts of the MSR and ZSL. No wire angle data need be recorded for neuston tows.

Processing of Ichthyoplankton

The processing is carried out in several steps: removal of all tar contaminants; measuring the volume of plankton in each sample; sorting out and enumerating all fish eggs and larvae and plastics; identifying all larvae; measuring certain larvae; identifying certain fish eggs and staging (aging) some; and curating all fish eggs and larvae.

All data are standardized and subjected to automatic data processing for final analyses and publication.

APPENDIX II. MARMAP SURVEY II OPERATIONS

Survey coverage proposed for implementation in FY 1978 and 1979 are described in this section. A map of the management areas to be surveyed is presented in Figure 2. Standard Survey II biological and environmental sampling will be performed in these areas.

Trawl Survey Sampling Design

A stratified sampling design is utilized on Survey II. The principal operational features as applied to the groundfish survey are:

A) The Continental Shelf and Slope to a maximum depth of 500 fathoms are subdivided into sampling strata corresponding to geographic and hydrographic subdivisions significantly related to fish distribution.

B) Locations of trawl stations are pre-selected within each stratum.

C) When diel movements are not biased, sampling is conducted on a 24-hour basis with the entire region being covered in the minimum time possible using a systematic cruise track that ignores stratum boundaries and tends to minimize steaming time.

NOTE: The maximum depth limits for Survey II Operations vary according to management areas and the types of demersal resources being investigated.

Selection of Stations

The selection of the cruise stations in each sampling stratum is made in conjunction with the preparation of the cruise plan. The precise location of each station is also plotted on the navigational charts to be used at sea. The number of stations is proportional to the area of the stratum, with a minimum of two stations in a stratum. The average for the New England Groundfish Survey Operations, for example, is about 4 1/2 stations per stratum. The range is from 2-10 stations, depending upon stratum size and priority.

Random selection of stations in very narrow, deep strata along the edge of the shelf is actually a two-stage process both ashore and at sea. That is, a station is first located with respect to latitude and longitude and then a specific trawling depth is selected. The second step is necessary because the design specifies that trawling be done along depth contours, and navigation alone is not sufficiently accurate to pinpoint a depth contour along a steep edge. As an example, for a stratum in the 100-200 fathom zone, one of the depth intervals (101-125, 126-150, 151-175, 176-200 fathoms) is randomly selected for each station in the stratum. Selections are without replacement since no more than 3 stations are allocated to such narrow strata. The selected trawling depth interval is recorded beside the station on the navigation chart for convenient reference at sea.

Acquisition of Vessel Services

NOAA vessels shall be acquired for Survey II Operations in accordance with current version of the NOAA Fleet Operational Plan. Services of non-NOAA vessels on a contract basis shall be acquired by the MPO through regular contracting procedures. The Program Manager or his designee shall ascertain the compliance of candidate vessels with MARMAP Survey II requirements as described in this plan and by the MARMAP System Description.

The MPO shall maintain a current listing of vessel service requests and commitments and the pertinent ship operating schedules.

Standard Sample and Data Acquisition Procedures

Trawl samples will be processed on-board. Only secondary samples (stomachs, gonads, scales, otoliths) and unusual specimens requiring special study will be returned to shore. The minimum routine data obtained in processing trawl catches is the total weight and length frequency of each finfish species in the catch, plus scale or otolith samples for a few important commercial species (particularly haddock) (Table II-1). A few invertebrates (lobsters, shrimp, scallops, and squid) are also recorded routinely. Depending upon the specific data requests and the availability of personnel, other common kinds of samples or observations performed include:

- stomach contents
- frozen or preserved specimens
- parasites
- gonads
- meristic or morphological observations

Processing the trawl catch is accomplished by dumping it into a waist-high checker. The fish are sorted into steel baskets of one and two bushel capacity, usually according to species. The catch of each species or sample of it is weighed to the nearest whole pound on a simple balance (steelyard) having a single point of attachment. (The accuracy of this method is ±10% for 10 lbs of fish. It is only ±25% for less than about 10 lbs of fish, however. Therefore, small catches are usually weighted in a small plastic pail attached to a simple spring scale.

TABLE II-1 REQUIREMENTS FOR SURVEY 2 AT-SEA SAMPLE AND DATA ACQUISITION

Information Required	Specific Parameters Measured	Minimum No. Samples or Observations (Depths) Per Primary Station	Depth Covered	Accuracy	Precision	Range
BIOLOGICAL						
Demersal fish abundance/diversity and distribution	- No. individuals in taxonomic categories - Weight by species		Near Bottom Near Bottom			
Epibenthis invertebrates abundance/diversity and distribution	- No. individuals in taxonomic categories - Weight by species		Near Bottom Near Bottom			
Age--specific fecundity and survivorship of demersal fish populations	- Length frequency* - Scales/otoliths (collected for subsequent analysis)* - Stomach samples (collected for subsequent analysis)* - Gonad samples (collected for subsequent analysis)*		Near Bottom Near Bottom Near Bottom Near Bottom			
Distribution and abundance of surface fish schools, mammals, & birds	- Direct visual observation		N/A			
Benthic infauna abundance/diversity and distribution	- No. individuals in taxonomic categories - Weight by species		Near Bottom Near Bottom			
Special biological information	- Parasites* - Rare or unusual specimens (collected for subsequent analysis)		Near Bottom Near Bottom			
PHYSICAL OCEANOGRAPHIC						
Water Mass Characteristics * **						
• Temperature-Depth • Salinity-Depth	Temperature Salinity or Conductivity	10 10	0 to 200m 0 to 200m	± 0.1°C ± 0.1°/oo ± 0.3 m F/I	± 0.02° ± 0.02°/oo	-2 to 35°C 0 to 40°/oo
Near-Bottom Water Mass Characteristics* **	Temperature Salinity		Near Bottom Near Bottom	± 0.1°C ± 0.1°/oo ± 0.3 m F/I		
Upper-Ocean Circulation Dynamics						
• Current Velocity (Direce Measurement) • Surface Wind Vector	Current Velocity Wind Velocity Wind Direction	1 1 1	200m 200m ----	± 10 cm/sec ± 5.0 kts ± 10°	± 0.1 KT ± 2°	10-100 cm/sec 0 to 50 KT 0 to 360°
METEOROLOGICAL (See Reference 4)						

* Number of species sampled and number of samples acquired per species will depend upon the nature of the data base for each species existent at any point in time.

** STD is to be used if available, if not available, bottle cast are to be used.

Measuring boards (some fitted with punch strips for large numbers of fish) are used for obtaining length frequencies to the nearest whole centimeter. Fork length is used except where not applicable, and then total standard length is recorded. Carapace lengths are taken for lobsters, mantle lengths for squid, wing-width for rays, and shell lengths for scallops, carapace length for pandalid and carapace width for crabs; peneid shrimp are weighed only.

Whenever practical, the entire catch of each species is weighed and measured. When sampling is employed, the following three requirements must be met:

- A representative sample of each species must be obtained.
- The sample must be large enough for a good estimate of the total weight and length frequency of each species.
- The size of the sample (weight, volume, number) relative to the total catch must be clearly indicated.

An outline of instructions for all types of sampling should be provided to all members of the scientific party and posted on the appropriate ship's bulletin board, as a number of different biological samples are taken on every survey cruise. Some of these are routine, e.g., scale and otolith collections, but many are not routine, particularly if visiting scientists are aboard. These instructions provide details on methods of sampling; e.g., stratified sampling by length for scale and otolith collections, sample sizes and preservation methods. Tally sheets should be posted for keeping a tow-by-tow tally of the samples collected to improve the efficiency of the sampling and particularly to help ensure that all the required samples are obtained. An outline of sampling procedures applicable to the basic catch data should also be posted on a bulletin board near the area where fish processing occurs.

Trawl specifications and groundfish survey equipment list are found in Figure II-1 and Tables II-2 and II-3, respectively.

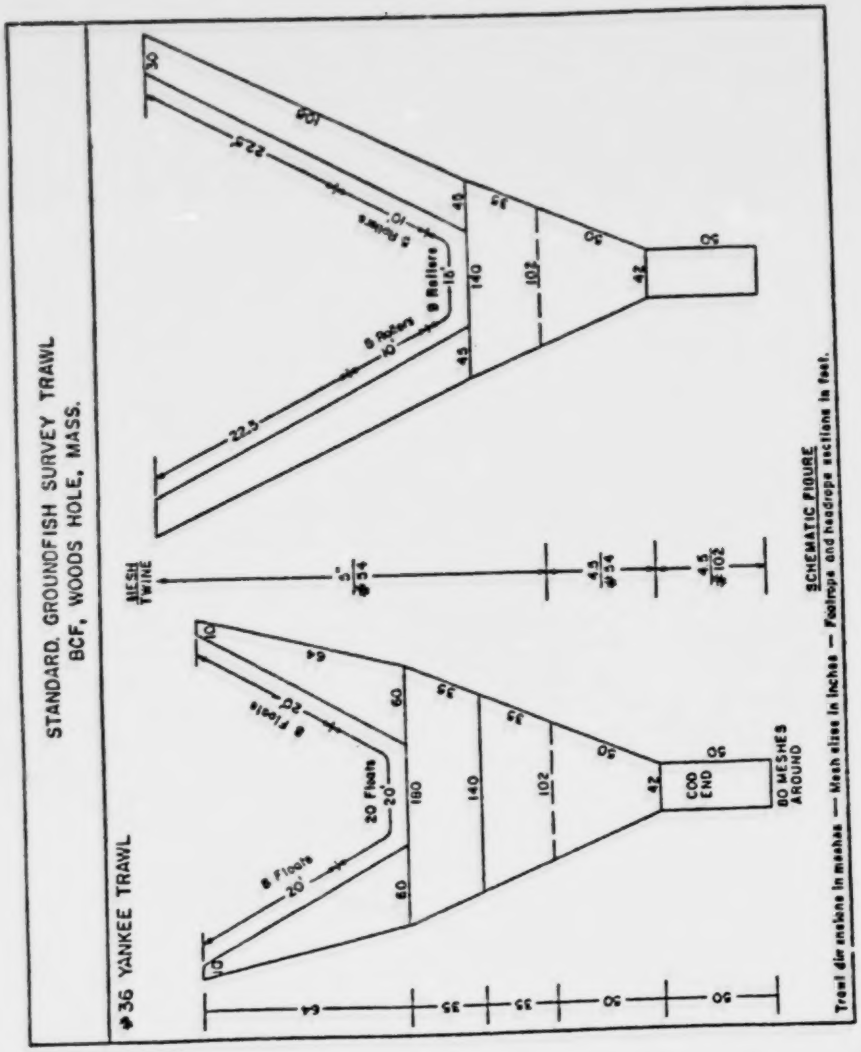
STANDARD GROUNDFISH SURVEY TRAWL
BCF, WOODS HOLE, MASS.
#36 YANKEE TRAWL
MESH
TWINE
5"
#54
4.5
#54
4.5
#102
8 Floats
20'
20 Floats
20'
8 Floats
20'
10
64
60
180
60
140
102
35
35
30
42
COD END
30
80 MESHES AROUND
64
35
35
30
30
8 Rollers
10'
8 Rollers
16'
8 Rollers
10'
22.5'
22.5'
30
106
49
140
49
102
35
30
42
30
SCHEMATIC FIGURE
Trawl dimensions in meshes — Mesh sizes in inches — Footrope and headrope sections in feet.

Figure II-1 Schematic drawing of standard trawl used on groundfish survey by Bureau of Commercial Fisheries, Biological Laboratory, Woods Hole, Massachusetts.

Table II-2

SPECIFICATIONS FOR THE STANDARD GROUNDFISH SURVEY TRAWL CURRENTLY IN USE BY THE NEW ENGLAND GROUNDFISH SURVEY

TRAWL PART	CONSTRUCTION DETAILS
Overall length (wing ends to cod end)	Approximately 98
Material and mesh sizes (stretched mesh, certified)	
Trawl	#54 Tan Nylon throughout. 5" mesh in wings, square and forward section of bellies; 4-1/2" mesh in aft section of bellies.
Cod end	#102 white Nylon, 4-1/2" mesh, 80 meshes around, 50 meshes long.
Liner	#147 Knotless White Nylon, 1/2" mesh, in two pieces; one piece attached 35 meshes up from aft end of top belly which lines about 60 meshes across center of top belly, and which extends about 2' into cod end; and one piece lining entire cod end and extended about 2' outside of cod end when open.
Headrope (total length)	60' in three 20' sections, 7/8" dia. comb. wire rope, eye at each end and joined by 7/8" patent (split) links.
Headrope hanging	
Square (Bosom)	14'
Wings	23'
Footrope (total length)	80' in five sections: 22-1/2', 10', 15', 10' and 22-1/2'; 3/4" dia. 6 x 25 galv. wire.
Footrope hanging	
Lower belly	10'
Wings	35'
Rollers	Hard rubber, 5" wide by 16" diameter separated by rubber spacers 6-7" wide by 5-1/2" diameter - center section of 15' with 9 rollers separated by two spacers - two 10' sections each with 5 rollers separated by three spacers.
Floats	8" diameter aluminum (spherical-no collar) deep sea type, 20 floats along center 20' sect of headrope, and 8 floats evenly spaced on each 20' side section.

Table II-3 REPRESENTATIVE GROUNDFISH SURVEY EQUIPMENT LIST

Equipment	Description/Type	Notes
Standard Survey Trawl	Specification for standard groundfish survey #36 Yankee trawl developed by NEFC at Woods Hole, Massachusetts, is contained in Appendix D.	Prior to each survey it is mandatory that the cruise coordinator and the mate in charge of trawl gear compare assembled trawls with the standard specifications. Experience indicates it is too easy for undesirable modifications to slip in as a result of temporary repairs becoming permanent, or because of a lack of proper spare net sections or other parts.
Other Nets	Bongo net adopted as standard plankton gear for Survey 1 (Specifications are available from Survey 1 Manager	
Dredge	Candidate device for sampling infauna has not been selected	
Instrumentation	Bathythermograph Echo sounders Salinity/Depth/Temperature (Measurement System) Miscellaneous instruments including: Thermometers Stop watches Counters Meter wheels	All of these instruments require maintenance, and their condition, including supplies of slides for BT's and paper for echo sounders, should be checked before each cruise.
Paper Supplies	Field logs Data sheets Envelopes and labels Cardboard boxes	
Miscellaneous Hardware	Assorted jars, and vials plastic and cloth bags and cheesecloth for preserving samples Measuring boards and punch strips. Spring scales and steel yards with weights. Steel baskets and plastic buckets and garbage pails. Knives, forceps and other dissecting instruments	
Chemicals	Formalin Glycerine Alcohol	
Reference Books		Identification of fishes is facilitated by references on fishes found in the area
Meterological Instrumentation	As described in Survey 1 Plan	

Appendix III

NEFC - Task Development Plans - FY 1980

By Division

TDP No.	Task No.	Task Name	Leader	Division	Location	BY + 1 Target Allowance	BY + 1 Increase
NEC-042-80-AQ-A-5	8AE4P1	Aquaculture Genetics	Longwell	Aquaculture	Milford	5/261.1	
NEC-043-80-AQ-A-5	8BE4P2	Aspects of Nutritional Requirements of Molluscs	Ukeles	Aquaculture	Milford	5/273.7	
NEC-045-80-AQ-A-5	8BE4P4	Spawning & Rearing of Molluscs	Landers	Aquaculture	Milford	6/272.4	
NEC-089-80-EI-A-5	8BC2F2	Cytology, Cytogenetics, Embryology & Development of Fish Eggs - Field & Laboratory	Longwell	Aquaculture	Milford	0/25.0	6/195.0
NEC-093-80-EI-A-5	New	Experimental Approach to Environmental Pollutants That Affect Phytoplankton Populations in the Ocean	Ukeles	Aquaculture	Milford		2/100.0
NEC-096-80-AQ-A-5	8BE402	Training - Molluscan Aquaculture	Hanks, J.	Aquaculture	Milford	0/67.5	
					TOTAL	16/899.7	8/295.0
NEC-084-80-FO-A-5	78A4Y4 88A4Y4	Ocean Climatology and Monitoring	Cook/Ingham	Atlantic Environmental Group	Narragansett	5/214.2	3/102.8

Appendix III cont.

By Division

TDP No.	Task No.	Task Name	Leader	Division	Location	BY + 1 Target Allowance	BY + 1 Increase
NEC-001-80-EI-A-5	88C2P1	Coastal Monitoring Assessment and Prediction (COMAP)	Kelly	Environmental Assessment	Woods Hole	3/146.5	2/57.5
NEC-033-80-EI-A-5	88C2P1	Behavior of Fishes Under Environmental Stress	Olla	Environmental Assessment	Sandy Hook	5/110.5	3/144.4
NEC-034-80-EI-A-5	88C2P2	Coastal Ecosystems	Reid	Environmental Assessment	Sandy Hook	7/168.8	5/139.0
NEC-036-80-EI-A-5	88C2P5	Biological Oceanography of Stressed Ecosystems	Thomas	Environmental Assessment	Sandy Hook	7/214.8	6/290.2
NEC-037-80-EI-A-5	88C2P8	Physiological Effects of Pollution Stress	Calabrese	Environmental Assessment	Milford	10/261.0	6/453.5
NEC-040-80-EI-A-5	88C2Q4	Environmental Chemistry	Greig	Environmental Assessment	Milford	2/66.6	4/424.3
NEC-085-80-EI-A-5	New	Ocean Pulse Contract: At Sea & Laboratory Experimentation & Vessel Support		Environmental Assessment			0/1000.0
NEC-086-80-EI-A-5	New	Ocean Pulse Contract - Benthic Sample Processing		Environmental Assessment			0/560.0
NEC-100-80-EI-A-5	New	Environmental Statistics	Chang	Environmental Assessment	Sandy Hook	1/00.0	3/160.8
					TOTAL	35/968.2	29/3,229.7
NEC-006-80-FO-A-5	88A4G2	Ecosystem Dynamics	Grosslein	Marine Ecosystems	Woods Hole	3/122.2	1/70.3
NEC-007-80-SI-A-5	88A2F2 78A2F2	Recruitment Processes	Lough	Marine Ecosystems	Woods Hole	4/413.3	0/60.0
NEC-008-80-FO-A-5	88A4G1	Fishery Oceanography: Environmental Studies	Wright	Marine Ecosystems	Woods Hole	8/467.2	2/47.5
NEC-009-80-RP-A-5	88F9F1	Oceanic Gamefish	Casey	Marine Ecosystems	Narragansett	3/149.0	1/49.4
NEC-012-80-SI-A-5	88A2F5	Physiology: North Atlantic Larval Fish	Laurence	Marine Ecosystems	Narragansett	5/154.6	3/122.1
NEC-014-80-SI-A-5	88A2F3	Plankton Ecology	Sherman	Marine Ecosystems	Narragansett	10/531.5	1/176.6
NEC-016-80-S2-A-5	88A2F4	Benthic Dynamic & Demersal Food Chain Studies	Wigley	Marine Ecosystems	Woods Hole	5/176.1	1/76.0
NEC-031-80-SI-A-5	88A2P2	MARMAP I: Biological Assessment	Smith, W.	Marine Ecosystems	Sandy Hook	12/348.8	1/31.0
					TOTAL	50/2,362.7	10/632.9

Appendix III cont.

By Division

TDP No.	Task No.	Task Name	Leader	Division	Location	BY + 1 Target Allowance	BY + 1 Increase
NEC-080-80-EI-A-5	88C2W1	Systematics of Selected Fishes & Crustaceans	Cohen, D.	National Systematics Laboratory	Washington, DC	9/236.2	0/21.6
NEC-038-80-EI-A-5	88C2P9	Disease and Environmental Stress	Murchelano	Pathobiology	Oxford	7/128.4	4/285.2
NEC-039-80-EI-A-5	88C2Q2	Life Studies: Comparative Pathobiology	Rosenfield	Pathobiology	Oxford	7/153.1	4/303.9
NEC-044-80-AQ-A-5	88E4P3	Aquaculture: Control of Molluscan Disease	Blogoslawski	Pathobiology	Milford	5/180.9	
NEC-092-80-SP-A-5	New	Facilities (Bldg Extension) (Health of Oceanic Fish and Shellfish)	Rosenfield	Pathobiology	Oxford		0/690.0
NEC-102-80-RF-A-5	New	Striped Bass Disease	Rosenfield	Pathobiology	Oxford	———	4/212.2
					TOTAL	19/462.4	12/1491.3
NEC-003-80-EI-A-5	88A3F1	Fishery Analysis: Multispecies Northwest Atlantic	Brown	Resource Assessment	Woods Hole	23/818.3	10/711.6
NEC-004-80-S2-A-5	88A2F1	Bottom Trawl Survey Operations	Azarovitz	Resource Assessment	Woods Hole	12/462.8	7/276.0
NEC-005-80-FE-A-5	88A3F3	Automatic Age Reader System Development	Nichy	Resource Assessment	Woods Hole	0/110.0	
NEC-019-80-S3-A-5	88A2F1	Pelagic Fish Survey Assessment Research (Hydroacoustics)	Anderson	Resource Assessment	Woods Hole	1/133.4	1/100.0
NEC-046-80-RF-A-5	88F9P1	Biological Assessment: Sportfish	Wilk	Resource Assessment	Sandy Hook	3/111.8	
NEC-055-80-EC-A-5	88F6F1EJ	Fishery Analysis: Economics	Brown	Resource Assessment	Woods Hole	11/596.6[1]	4/296.6
					TOTAL	50/2232.9	22/1384.2

[1] Currently 8/196.6 (3/400 - FY 79 increase)

Appendix III cont.

By Division

TDP No.	Task No.	Task Name	Leader	Division	Location	BY + 1 Target Allowance	BY + 1 Increase
NEC-010-80-FE-A-5	88A5G2MC	Sampling and Harvesting Gear Development	Corbett	Resource Utilization	Gloucester	4/118.3	3/200.0
NEC-070-80-PT-A-2	88F810	Product Quality, Safety & Standards	Gadbois	Resource Utilization	Gloucester	9/267.2	3/200.0
NEC-072-80-PT-A-2	88F719	Resource Development and Improvement	Learson	Resource Utilization	Gloucester	14/409.9	2/100.0
NEC-079-80-RF-A-5	New	Sportfishing Utilization Technology	Learson	Resource Utilization	Gloucester	______	3/79.0
					TOTAL	27/795.4	11/579.0
NEC-013-80-S2-A-5	88A2F6	Biochemical Stock Identification	Ridgway	Unattached	Woods Hole	0/3.1	
NEC-017-80-S2-A-5	88A2F7	Manned Undersea Research and Technology	Cooper	Unattached	Woods Hole	5/132.7	2/150.0
NEC-020-80-SP-A-5	900040	General Support	Stern	Unattached	Woods Hole	72/2012.5	
NEC-032-80-FA-A-5	88A3P1	Data Management	Pacheco	Unattached	Sandy Hook	4/148.7	2/41.6
NEC-050-80-FA-A-5	83A3F2	Northeast Fisheries Data Processing & Information System Development	Heyerdahl/ Handy	Unattached	Woods Hole	8/446.5	5/400.0
NEC-051-80-RF-A-5	88F9F2	Aquarium	Wheeler	Unattached	Woods Hole	3/97.5	0/27.0
NEC-053-80-00-A-0	New	Vessel Construction		Unattached			0/3500.0
NEC-054-80-00-A-0	New	Facility Addition - Building Construction		Unattached			0/1250.0
NEC-056-80-FA-A-5	88A3F4	Fishery Analysis: Management Council Liaison	Smith, K.	Unattached	Woods Hole	2/67.5	1/20.8
NEC-101-80-EI-A-5	New	Rehabilitation of Seawater and Aquarium System	Sindermann	Unattached	Sandy Hook		0/167.0
NEC-103-80-00-A-0	New	Construction of Vessel Pier		Unattached			0/1098.0
NEC-104-80-00-A-0	New	Acquisition of Two Inshore Research Vessels		Unattached		______	0/1300.0
					TOTAL	94/2908.5	10/7954.4
					GRAND TOTAL	305/11,080.2[1]	105/15,690.9

[1] Currently 10,680.2K (3/400 - FY 79 increase NEC-055)

APPENDIX IV - PHYSIOLOGY-BIOCHEMISTRY, MILFORD, CONN.

Sampling Protocol

Samples of organisms will be taken from both "clean" and impacted areas.

Teleosts

A. Sampling: 10 individuals per sp at selected clean and impact stations.

B. Treatments:

1. Excise kidney, brain, and 1-2 g gonad
2. Place each in small plastic bag, pinch and fold to get out as much air as possible; wrap tightly with masking tape and label (use code; sample data sheet is enclosed).
3. Freeze at as low temperature as possible.
4. Take blood samples from winter flounder and yellowtail flounder and any other species where 10 or more individuals are available. Centrifuge blood and save and freeze serum. Discard cells.

C. Species, in order of importance:

Flounder (yellowtail, winter), Gadoids (cod, haddock, pollock), Clupeids (herring, alewife), and Mackerel

Crustaceans

A. Sampling: as for teleosts

B. Treatments:

1. Excise, package (as shown above), and freeze gonads (all), digestive gland (1-2 g), and blood.
2. Return live specimens from end-of-cruise stations to the laboratory.

C. Species, in order of importance:

Lobster, Jonah Crab

Molluscs

A. Sampling: as for teleosts

B. Treatments:

1. Excise, package (as above), and freeze gills, adductor muscle (1-2 g), mantle, and gonads.

*2. Return live specimens as for crustaceans.

C. Species in order of importance:

Ocean Scallop, ocean Quahog, other spp. of opportunity

D. Sampling procedure for sea scallop (Placopecten magellanicus) Adductor muscle, taken at sea:

1. Sampler per station = An optimal number would be at least 12 animals taken at each station, if possible.

2. Data needed =

a) Keep accurate log of station number (salinity, temperature, depth) and date, and please make copy for me.

b) Please note size (cm) and sex (relative ripeness of gonad would also be helpful) of each animal from which adductor muscle is taken.

c) Use your own code, but samples for each station should be numbered, to keep track of size and sex.

3. Sampling procedure proper:

a) Excise adductor muscle as cleanly as possible (so no gonad tissue, digestive gland, or whatever, will contaminate the muscle tissue); cut away the outside of the muscle, if necessary or if it's easier, we only need about 2 grams.

b) Place tissue in small plastic bags (home-made from Zip-Lock bags, supplied in box with tape and marker) and squeeze around to eliminate as much air as possible, then

c) Wrap tightly with masking tape, number (or whatever your system is), and freeze-store** by station groups, as was done on the Sept. '77 cruise.

4. When off-loading ship, the best treatment would be to store the samples with some hunks of dry ice in a freezer, to await pick-up and transport to the Milford Laboratory.

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*Please bring back to the laboratory live lobsters, crabs and bivalve molluscs caught during the last three days of the cruise.

**The lower the temperature, the better--20°C would be very good.

Water Column Biology Panel Addendum

I. In order to develop good baseline data standardized methods of sampling are necessary.

A. Zooplankton - Bongo Samples

The standard sampling gear for MARMAP[1] ichthyoplankton operations is the Bongo net array consisting of two cylindrical mouth pieces 61 cm in diameter inside of which are fastened flowmeters. The port cylinder is fitted with a 0.505 mm mesh net and the starboard with a 0.333 mm mesh net. A 45 kg depressor and a TDR (time-depth recorder) is attached to the array. The standard tow is the double oblique to within 5 m of the bottom or a maximum of 200 m. No time is spent at depth. The towing wire is payed-out at the rate of 50 m/min and retrieved at 20 m/min. Towing speed is 1.5 to 2.0 kn. Flowmeter readings are recorded before and after each tow, the TDR is checked for the maximum depth of gear after each tow.

Plankton is gently washed from the net into a bucket then drained through a sieve having smaller meshes than the net. Plankton is transferred to a glass jar and preserved in 4%

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[1] Adapted from MARMAP Survey I Manual. Prepared by J. Jossi, R. Marak and H. Peterson. 1975. NOAA/NMFS.

buffered formalin. Each jar has an inside and outside top label indicating vessel, cruise, station, gear type and mesh size. Additional information is recorded on the standard MARMAP Zooplankton and Master Station record logs.

B. Zooplankton - Neuston Samples

For neuston, near surface zooplankton and contaminants such as tar, oil, and plastics, the standard gear is the MARMAP[1] neuston net which is a 1.0 m x 0.5 m frame made of aluminum pipe fitted with a 4.9 m long conical net of 0.505 mm mesh. The standard tow is made with the net 1/2 submerged for 10 min at 2.0 kn. The sample is handled in the same manner as the Bongo samples.

C. Special Samples - Microplankton, Phytoplankton

The standard sampling gear for microplankton including phytoplankton is the 20 cm Bongo array which is fitted with 0.253 mm and 0.165 mm mesh nets and flowmeters. These are attached to the towing wire just above 61 cm Bongos so that towing procedures are the same as those described in "A.".

II. Integrated approach for studying the effects of oil on ichthyoplankton.

A. Sampling, sorting and identification of fish eggs

1. Observations of condition of eggs and larvae at time of capture
2. Numbers/100 m^3
3. Distribution
4. Species and community composition
5. Comparison with data from previous years
6. Food web implications

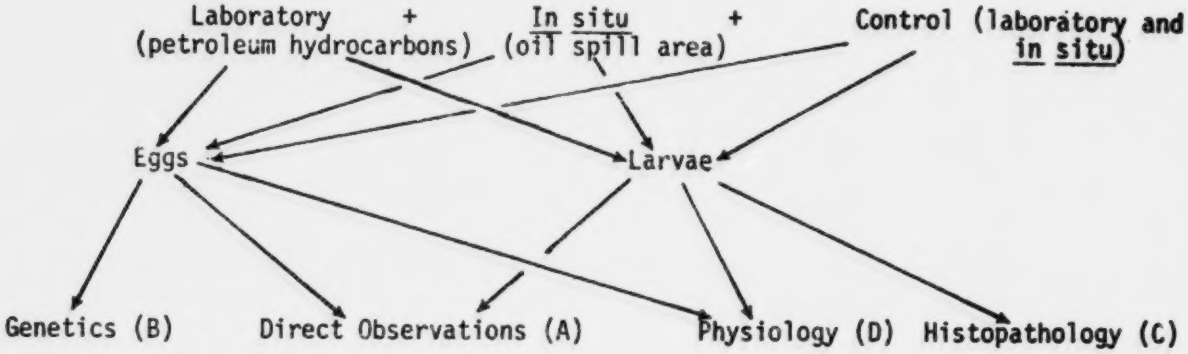
B. Genetics - Embryos

1. Sampling
2. Identification
    a. species
    b. stage
3. Examination (cytogenetics - Longwell, 1976)
4. Results (%)
    a. morbid
    b. moribund
    c. abnormal embryos
    d. chromosome damage

C. Histopathology - Examination of larvae from clean and spill areas for histological changes.

D. Bioassay - Effects of oil on developing embryos and larvae - at sea and laboratory studies. See Water Column Biology (4). Schematic approach:

Bioassay Experiments - Laboratory produced eggs & larvae


Laboratory (petroleum hydrocarbons)
+
In situ (oil spill area)
+
Control (laboratory and in situ)
Eggs
Larvae
Genetics (B)
Direct Observations (A)
Physiology (D)
Histopathology (C)

HISTOPATHOLOGY PANEL

Participants

P.P Yevich, Chairperson
R.S. Brown
C.A. Farley
G. Gardner
J.W. Hurst, Jr.

HISTOPATHOLOGY PANEL

General Considerations

BACKGROUND INFORMATION

A. Objective:

The objective for histopathology studies related to oil spills is to determine whether or not the cell tissues of animals which have been collected from the oil spill sites show any morphological or histochemical changes which can be attributed to the oil. However, some of the difficulties in achieving this objective result from our lack of knowledge as to what constitutes a normal situation for the area from which the animals are collected. We need physiological, seasonal, and cyclic morphological baseline data for the majority of marine species. Information is now becoming available as to what is histologically normal in many of the commercially important marine species (oysters, mussels, blue crabs, quahogs, soft shells, and scallops). This information is being prepared for publication in Atlas forms by EPA & NOAA, and possibly the BLM program.

B. Recommendations:

1. Histopathologic studies must be correlated with analytical studies.

2. We will collect whatever species are available at the spill. However, the selection of the species will be at the discretion of the histopathologic investigator who may not be looking for the most sensitive species but for an indicator species.

3. Histopathology experts should be invited to all spills. However, what animals are to be collected should be left to the discretion of the histopathologic investigator.

4. Where and how animals are to be necropsied is left up to the discretion of the investigator.

5. Fixation, trimming, and slide preparation is left up to the discretion of the investigator.

6. The number of collections per oil spill site shall be determined by the histopathologic investigator and the

circumstances of the oil spill. Of greatest interest are the chronic histopathologic effects of the oil spill.

7. Close coordination should be maintained with the Laboratory Toxicity group as to the histopathologic findings in the field animals. For histopathology efforts to be of any value for socioeconomic analyses, we must show a cause-effect relationship.

8. There is a lack of funds and trained people in marine histopathology in the U.S. and ways were discussed for training of these people.

C. Recommended Reference:

Yevich, P.P. and C.A. Barszcz, 1977. Preparation of Aquatic Animals for Histopathological Examination. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio. 20 pp. (Preliminary - Subject to Revision)

HISTOPATHOLOGY PANEL

Recommended Projects

1. To determine the histopathologic effects of an oil spill on marine organisms.

PANEL: HISTOPATHOLOGY
PROJECT NO: 1
PRIORITY RANK:

1. Project Title: To Determine the Histopathologic Effects of an Oil Spill on Marine Organisms

2. Project Description:

Morphologic study of cells and tissues from oil exposed and control animals will be conducted using the light and electron microscopes. Histochemical methods will also be utilized to determine any chemical changes which may be taking place in the cells and tissues. This will provide insight on any tissue changes taking place in the exposed animals. Comparison of cells and tissues of the control animals using the same methods and baseline data will give us some indication as to whether or not these changes are due to the oil.

The methods and techniques employed are the same as those used by animal, (experimental), and human pathologists during the past 50-100 years.

3. Performing Organizations:

Paul P. Yevich
Histopathology Unit
ERL - Narragansett

Austi Forley
Pathology Br.
NMFS - NOAA
Oxford, Maryland

Dr. Robert Brown
Marine Pathology Laboratory
University of Rhode Island
Kingston, R.I.

4. Applicable Habitats:

Most of the habitats listed in the New England list would be applicable.

5. Applicable Conditions:

Studies should be limited to major oil spills which have impacted large populations and organisms which can be identified by location.

6. Applicable Oil Type:

All types of oil spills should be studied.

7. Time Frame:

Studies will commence with controls, become more significant after 2 weeks and continue until no effects are seen histopathologically. Species should be selected on the basis of availability at the site and at comparable controls. Samples should include at least 30 animals and be collected weekly for the first month, monthly for the next 5 months, and then quarterly for 2 years. Other sample collections should be made available to the investigator for a period of up to 10 years. Birds, mammals and other various organisms should be examined when requested or when gross pathology is evident. Samples of all species should be at least fixed and archived.

8. Cost:

Slide preparation and histopathologic analysis of the slide runs anywhere from $12.00 to $15.00/slide. It will cost $12,000 per species for a 2-year study, $5,000/species for a 6-month study.

Travel and preparation of reports - $50,000.

9. Equipment Needs/Equipment Available:

A field model kit containing fixatives, alcohol for storage of specimens, bags, shucking knives, etc. has been constructed by the Histopathology Unit of ERL-N. Some improvements will be made and it is hoped that these kits will then be made available for histopathologists who respond to oil spills.

A manual for the preparation of aquatic animals for histopathologic examination has been prepared by the Histopathology Unit of ERL-N and will be distributed throughout the country to interested people.

A histopathologic technique manual prepared by the Pathology Br. of the NMFS. NOAA Labs, Oxford, Md. will soon be available to interested people.

Necessary equipment for the preparation and analysis of microscopic slides is available at the institutions listed in #3.

10. Facility Needs/Facilities Available:

See list in #3.

11. Personnel Needs/Personnel Available:

See list in #3. However, there is need of more people and organizations to get involved in marine histopathology. There is a great shortage of marine histopathologists and means should be provided for training them.

12. Support Services:

In order for this project to function properly, the histopathologist should be informed as to the possible oil spill impact, etc. by the on-scene coordinator. Also close coordination should be maintained with the analytical chemists who will be doing hydrocarbon determinations of the animals. In fact, when specimens are collected, they should be collected from the same time, area, species, etc. as those collected for the analytical chemists.

13. Payoff:

We have little knowledge as to histopathology effects of oil on marine life, we thus would be making contributions in this area.

Causes of death to the animals especially in cases of chronic exposure (5 to 10 years) in which we have a slow depletion of a population of animals once the oil spill site has been cleared.

Correlated with laboratory toxicity studies - a cause and effect relationship.

Possible carcinogenic potentials of petro-chemicals.

14. Limitations:

Histopathology would be of use only on animals which have come into contact with the oil in some form or manner.

LABORATORY TOXICITY PANEL

Participants

J. Gentile, Chairperson

J. Atema
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K. Simon

LABORATORY TOXICITY PANEL

General Information and Guidance

- Initial Considerations
- Specific Research Considerations
- Miscellaneous Information

INITIAL CONSIDERATIONS

A. Research Thrusts

The Panel reviewed the action plan and focused on three factors in guiding lab studies:

1. Studies that assist and support the on-scene coordination functions and decision making.
2. Post-spill damage assessment and dollar impact.
3. The utilization of a spill as a research opportunity.

The Panel produced the 15 research areas enumerated below in order of presentation.

1. Time dilution bioassay studies using field verified dosing regimes to plankton and meroplankton.
2. Test effects of long-term exposure on normal development and reproduction for selected commercially important species.
3. Field exposed organisms returned to lab and a variety of response parameters measured and recovery evaluated. These studies potentially involve repeated field collections of infaunal benthos to assess long-term effects.
4. Effects of tainting on predator-prey relationships.
5. Effects of oil contaminated sediment upon the reproductive potential of benthic fish.
6. Long-term physiological and behavioral adaptations.

7. Comparative toxicity of petroleum and dispersant mixtures.

8. Comparative toxicity of various types of oils.

9. Chronic oil exposure to commercial infauna.

10. Effects of seasonality on toxicity.

11. Effects of oil pollution on species distribution and structure in microcosms: planktonic and soft body benthic.

12. Large scale controlled lab studies on structural assemblages.

13. Research on bioaccumulation of petroleum hydrocarbons in commercial species and human health hazards from consumption of these species.

14. Standardization of bioassay methods.

15. Intertidal modeling of benthos to simulate natural exposure. Looking at tumor induction, fish disease and parasitism.

The panel summarized this diverse list into the following categories:

- Time-Dilution Models for Plankton/Meroplankton
- Field Exposed - Laboratory Assessed Studies
- Standardization and Testing of Major Petroleum Hydrocarbon Types Singly and in Combination with Available Dispersants
- Microcosm Research
- Health Effects
- Large Scale Structural Assemblages.

The panel decided they could not rank these categories by importance because spill situations are variable. It was generally concluded that the potential long-term effects were in the benthos for near-shore spills. In terms of research that should be implemented now, the third category (hydrocarbon testing) was highlighted. These data would be invaluable to the on-scene coordinator.

B. Recommendations to the Workshop Executive Committee

Two problem areas were highlighted for further consideration by the Executive Committee:

1. Clarification of funding to on-going research efforts. Is funding added to existing programs and the commitments delayed?

2. The subject of dollar value for liability.

It was recommended that population models and catch data for regionally important species be centrally available and that specialists in this area be used to project impacts. Also resource economists should be retained to calculate the possible ramifications.

C. Corporate Capabilities

The panel discussed with its corporate members their capabilities and contributions. There appears to be substantial laboratory bioassay expertise in this geographical area. The role of state support in laboratory toxicity studies was not dealt with initially.

SPECIFIC RESEARCH CONSIDERATIONS

A. Species and Parameters

The panel decided that to recommend a list of test species would not be appropriate. We recommend the following criteria be used as guidance for species selection:

- Select species representing pertinent feeding types that reflect the major routes of pollutant entry to the biota.
- Select indigenous and/or representative species from the following groups: fish, crustacea, molluscs, polychaetes, echinoderms, and macroalgae.
- Other factors that must be considered on a spill by spill basis are ecological or commercial significance, suitable life stage, appropriately sensitive species, availability of species from field or culture.

Parameters to be included in laboratory assessments are quite numerous and specific to the research design. Generally, short-term measures of stress such as biochemical, physiological, behavioral, and histological effects should be correlated with growth and reproduction and tissue residues whenever possible. Measures of stress for microcosms and community assays should include both functional and structural components whenever possible.

B. Role of Analytical Support

The role of Analytical Support was discussed with emphasis upon realistic assessment of water, tissue, and sediment analysis for each experimental design. We emphasize the careful deliberation on how the data is to be used and how the application affects choice and sophistication of analysis. Total hydrocarbon may frequently be sufficient to establish a causal relationship.

A second order Analytical problem involves quality assurance. There must be a coordinated Chemistry Section effort to assist the biologist in selecting a contractor and to assure the quality of the data.

Several questions were raised regarding site coordination problems. The panel feels that a specific hierarchy be established that includes an on-scene coordinating biologist and chemist to direct activities in these areas. The OSC can't cope with all the factors. The biologist will also make a list of participating institutions and researchers that can be mobilized rapidly.

Another useful approach that was recommended is to train state wildlife and pollution personnel to handle many of the collection functions.

C. Microcosm Research

The applicability of microcosms in spill assessment research was discussed. It was concluded that microcosms are at present best utilized to study basic research needs and have limited applicability in frequent spill assessment.

D. Testing for Health Hazards in Seafood

In any assessment of oil spill impact, the health hazards to man must be considered, especially when it involves closing down a fishery. The major questions in this regard are the following:

1. How is it determined when a fishery could be closed because of a health hazard?
2. How extensive is the area to be closed?
3. How long should an area remain off limits?

In order to answer these questions, various tests to assess the health impact studies should be conducted along with more research. These studies should include organoleptic tests for tainting and relating the results to specific hydrocarbon levels. It appears that U.S. Food and Drug Administration may set recommendations for safe levels of PNA's and other carcinogens in seafood in the near future. Consequently, fish from oil spill areas should be evaluated for specific PNA's. Furthermore, seafood extracts should be assayed for carcinogens by tests such as the Ames test, DNA repair or cell transformation. Chromosome breakage in field or lab exposed animals might also be indicative of the presence of carcinogens and mutagens. This is of practical interest because it has been shown that concentrates of polluted shellfish have produced cancers in test animals.

MISCELLANEOUS INFORMATION

A. Problems Related to the Role of the On-Scene Coordinator

The following were raised as relevant problems faced by the OSC:

1. Toxicity of oil of all types to species in impact area (e.g., shellfish, fish, etc.).

2. Identification and comparison of oil spilled for enforcement action and damage assessment, especially in the case of weathered oil.

3. Species collection and preservation in impact area for short-term effect of spilled oil.

4. Health Data to establish minimum criteria for shellfish, finfish, etc., in impacted areas. Total Hydrocarbons should be used as criteria or fractions thereof.

B. Massachusetts Information

The following information was provided on Massachusetts State facilities:

1. Lawrence Laboratory

   - 3 Gas chromatographs/minicomputers
   - 1 UV Fluorescence Spectrophotometer

2. Cat Cove Laboratory

- 1 Gas chromatograph
- 1 UV Fluorescence Spectrophotometer

During the Argo Merchant and Bouchard 65 incidents, both labs combined forces and could run 5 GC samples/day. Cat Cove prepared samples and Lawrence ran the samples.

C. University of Rhode Island - MERL

The URI Marine Ecosystems Research Laboratory (MERL) is funded by the EPA and is currently operating 12 large scale microcosms (13 m^3) in an experimental program designed to assess the effects of chronic, low level oil pollution upon temperate-coastal marine ecosystems. MERL research currently in progress is directly applicable to Laboratory Toxicity Panel Projects Nos. 1, 4, 6 and 8. Preliminary information concerning these projects may be discussed with Dr. Gabriel Vargo, Assistant Manager, MERL.

LABORATORY TOXICITY PANEL

Recommended Projects

1. Parallel benthic bioassay for single species or natural benthic assemblage (box core).
2. Standardized toxicity testing of petroleum and oil-dispersant mixture to marine biota.
3. Damage effects of oil-dispersant mixtures under simulated field conditions: use of large assay containers.
4. *In situ* acute toxicity tests.
5. Time dilution bioassay on holoplankton and meroplankton.
6. Sublethal effects of chronic exposure to low levels of petroleum hydrocarbons in zooplankton.
7. Effects of oil tainting of prey on food selectivity and feeding behavior of two predatory fish species.
8. Effects of oil-spill contaminated sediment on reproduction of winter flounder, *Pseudopleuronectes americanus* (Walbum).
9. Effects of chronic exposure to oil on representative marine animals.

PANEL: LABORATORY TOXICITY
PROJECT NO: 1
PRIORITY RANK:

1. Project Title: Parallel Benthic Bioassay for Single Species or Natural Benthic Assemblage (Box Core)

2. Project Description:

   The general philosophy of this research approach is to periodically remove either single species or a natural benthic assemblage that was impacted by a spill, transport to a mobile or fixed laboratory and assess physiological, behavioral, shell microstructure, biochemical, histological, integrative or conservative biological parameters, and tissue and sediment residues. Determine lab recovery patterns from those occurring in the field as well as new recruitment in the field. The critical aspect of this study is that the dosing is natural and integrative. There is a general feeling of inadequacy about lab dosing benthic systems. This approach is concerned with natural dosing of benthic communities.

   Such a research design will correlate a variety of stress measures with recovery time under natural conditions giving a true assessment of damage. This approach eliminates the problem of projecting field results from purely lab studies since they are being run concurrently. Sessile infaunal and epifaunal communities are especially well suited for these types of studies as are commercially important shell fisheries.

3. Performing Organizations:

   University laboratories with sources of running seawater and marine labs (i.e., URI, U. of Massachusetts @ Gloucester, U. of Maine, U. of New Hampshire @ Jackson Lab). EPA/NOAA labs and private consultants located in New England area.

4. Applicable Habitats:

   Clam/mud flats; offshore bottom; oyster-mussel reef.

5. Applicable Conditions:

   A. Demonstration of oil impact on community.

   B. Large impacted area of similar community structure to allow repetitive temporal sampling.

C. Accessibility to divers and/or sampling ($\leq$ 30 meters).

6. Applicable Oil Type:

Any oil type would be applicable.

7. Time Frame:

Such studies should have a minimum duration of one year to cover reproductive, growth, and recruitment parameters. Also, rates of biological uptake and/or depuration can be seasonally assessed. Field sampling should be once monthly at a minimum. If possible, sampling could be as frequent as every other week during spring and summer.

Follow-up studies with less intensive sampling (seasonally) schedules could continue for up to three years depending on habitat significance (liability) and data base.

8. Cost:

Such a study would require from $100K to 200K/year depending on sampling frequency, vessel expense, analytical chemistry needed and number of parameters measured.

9. Equipment Needs/Equipment Available:

Benthic samplers (Peterson Grabs). Box Core samplers, tanks for transporting organisms. Necessary analytical chemistry support and instrumentation (unless contracted). Lab requirements include flowing seawater, troughs and tanks, and depending on measured parameters any number of things. For example, feeding studies require algal culturing and counting equipment; respiratory studies require D.O. measuring devices; shell microstructure studies require = $30K in scopes, grinding equipment and accessories.

10. Facility Needs/Facilities Available:

Cruise time, analytical lab and wet lab for any applicable habitat. Diving capability and support.

11. Personnel Needs/Personnel Available:

Need benthic biologist with expertise in molluscan biology and benthic community ecology. Support personnel needed for lab studies include experienced technician. Divers also need sample collection as well as analytical capability. Currently such assessment techniques are not routinely available. EPA-Narragansett staff will have most capabilities by January 1978. Having settled on design details for such studies a training program and/or identification of other experts could be forthcoming.

12. Support Services:

A. Total areal impact of spill on benthos.

B. Analytical support for tissue and sediments.

C. Shell microstructure contract (Yale U.).

13. Payoff:

The principal output would be a real world assessment of initial damage, latent effects and degree of recovery with time. Furthermore, one can correlate lab measures of stress with actual field impact. By monitoring the indigenous populations temporally, one obtains a meaningful measure of duration of impact. With reliable areal information both duration and extent can be realistically measured. The cost/liability estimates would have a meaningful base.

14. Limitations:

The field sampling limitations involve patchiness of exposed habitat and selection of a similar but unimpacted control population. A direct causal relationship may be difficult to verify and may only be inferred, since populations in exposed and control areas may have different histories, etc.

PANEL: LABORATORY TOXICITY
PROJECT NO: 2
PRIORITY RANK:

1. Project Title: Standardized Toxicity Testing of Petroleum and Oil-Dispersant Mixtures to Marine Biota

2. Project Description:

To conduct static acute toxicity bioassays with petroleum, chemical oil dispersants, and oil-dispersant mixtures using selected marine indicator species. Methodology is as outlined in Annex X of the Federal Register. Results are essential for use of on-scene coordinator in dispersant application recommendations. Methodology and some results reported in detail in La Roche et al., 1970 JWPCFed 42:1982-1989.

3. Performing Organizations:

   A. EPA ERL-Narragansett

   B. RFP for industrial contract

   C. Manufacturer's responsibility as outlined in Annex X--although none have complied to date.

4. Applicable Habitats:

Salt marsh, shallow salt pond, rocky shore, sand shore.

5. Applicable Conditions:

As outlined in Annex X; mixtures should reflect manufacturer's recommended application dosages.

6. Applicable Oil Type:

All types of oils-preferably restricted to products transported via VLCC in excess of 100,000 tons annually in local waters.

7. Time Frame:

Four man-years -- continuous bioassay testing of 96 hour duration, approximately 5 dispersants tested weekly vs 6 oils. This should cover all dispersants now sold commercially.

8. Cost:

$120k ($30k/man-year)

9. Equipment Needs/Equipment Available:

As specified in Annex X.

10. Facility Needs/Facilities Available:

As specified in Annex X.

11. Personnel Needs/Personnel Available:

Ron Eisler available for providing instruction at ERL-Narragansett in oil-dispersant testing. Four GS-5 level personnel can be trained in 2 weeks, but assays must be conducted under senior biologist supervision.

12. Support Services:

As indicated in Annex X.

13. Payoff:

Recommendations by OSC to apply dispersants and other oil-counteractants are dependent on a solid data base. This data base is nonexistent at present--at least for the several hundred chemical oil dispersants now in use.

14. Limitations:

As outlined in Annex X; especially tests of dispersant chemical effectiveness.

PANEL: LABORATORY TOXICITY
PROJECT NO: 3
PRIORITY RANK:

1. Project Title: Damage Effects of Oil-Dispersant Mixtures Under Simulated Field Conditions: Use of Large Assay Containers

2. Project Description:

Current oil-dispersant toxicity evaluations are conducted under static conditions in small jars using comparatively small indicator species. Failure to consider known depth protective effects in large, deep flow-through systems (Eisler, 1975 API Proceedings, San Francisco 535-540) lowers credibility to OSC of data derived from standardized (i.e., Annex X) toxicity tests.

Tests proposed herein would be conducted in large, deep, flow-through systems using adults of economically important coastal and offshore species, and others where appropriate. Primary emphasis would be on survival and whole body residues during exposure and afterwards, sublethal and latent effects including biochemical, physiological behavioral, and histological data could also be collected. Results of these studies would be useful in (1) assessing ecological damage effects of petroleum and oil-dispersant mixtures (2) establishment of hydrocarbon residues in marine products of commerce which are (a) not harmful to human health and (b) do not significantly affect integrity of brood populations.

3. Performing Organizations:

EPA - Edison, NJ

EPA - Narragansett, RI

US Army Corps of Engineers

RFP

4. Applicable Habitats:

All

5. Applicable Conditions:

Mixing energy for oil-dispersant combinations must be calibrated; sediment types and amounts should be established; distance from surface variation should be determined; HC levels in water column known.

6. Applicable Oil Time:

Applicable to all crude oils; and oil-dispersant combinations at manufacturers recommended dosages (use of dispersants contraindicated in spills of gasoline and other highly refined products).

7. Time Frame:

First year (reevaluation afterwards): screening of the five most promising dispersants (derived from Annex X data) together with appropriate target oils. A typical study would last 2 to 3 months with a total of 48 to 72 separate studies planned during this interval (see equipment section). This is a multidisciplinary approach recycling heavily on aquatic toxicologists, and analytical chemists. A minimum of 5 man-years is necessary. This can be expanded to 10 man-years if supplemental data on biochemical, physiological and other stress profiles are acquired (strongly recommended).

8. Cost:

At $30K/man-year, minimum personnel costs would be $150K, maximum 300K. Construction costs would approximate $125K.

9. Equipment Needs/Equipment Available:

A minimum of six large tanks are required, each of approximately 20 meters in length, 4 meters by 4 meters. Tanks should be continually supplied with raw seawater and bottom exit drains and equipped with cage-like compartments at discrete intervals from surface to bottom. These tanks do not exist at present. Conventional glassware and other equipment are available at ERL-Narragansett for organisms.

10. Facility Needs/Facilities Available:

Needs: (1) holding facilities (2) analytical capability (GC-MS9; water chemistry analysis); histology and biochemical facilities. These are all available at ERL-Narragansett.

11. Personnel Needs/Personnel Available:

Availability of personnel unknown. Disciplines required include aquatic toxicology, marine biochemistry, analytical petroleum chemistry, histology, marine behavior, and aquatic physiology.

12. Support Services:

Dispersant effectiveness must be established under these conditions. Degradation of petroleum and levels in water column and sediments should be monitored. Quality control of indicator species.

13. Payoff:

A. Establishment of HC residue levels for protection of aquatic life and human health.

B. Establishes link between Annex X data and field testing of oil counteractants.

C. Unique scientific contribution on basis of test facility and multidisciplinary approach.

D. Provides OSC with decision making capability.

E. Provides data for predictive model capability for assessing economic damage of large scale spills and selected oil dispersant counteractants.

14. Limitations:

Contingency on (a) construction of test facility, (b) availability of technical expertise (some could be fixed on a one-year temporary basis) and (c) needs validation with field testing.

PANEL: LABORATORY TOXICITY
PROJECT NO.: 4
PRIORITY RANK:

1. Project Title: *In situ* Acute Toxicity Tests

2. Project Description:

Mobile lab aboard work boat at spill site.

Indigenous species, representing several major groups (molluscs, polychaetes, crustacean, fish) collected from a field control site are exposed to (a) oil-contaminated water from spill site in dynamic (flowing) water systems to determine toxicity under field conditions (i.e., in the presence of physical, chemical, microbial, etc. factors present at site). (b) Samples of water to be collected for chemical analyses by appropriate techniques (e.g., GC/MS, LC, etc). (c) Dispersants can be mixed with incoming oil-contaminated seawater to determine effects of dispersants on toxicity of oil-dispersant mixtures under field conditions. On the basis of this test, the least harmful dispersant could be selected for clean-up (presumably only dispersants considered to be effective in dispersing the oil in question would be tested as to effects on toxicology).

3. Performing Organizations:

EPA

EG&G Bionomics

4. Applicable Habitats:

Study could be performed (a) near shore with mobile lab located on-shore and pumping systems conducting oil-seawater to lab. (b) offshore with mobile lab on work boat.

5. Applicable Conditions:

Weather conditions would have greatest impact on ability to perform study of this type. Tests would be difficult under heavy weather conditions with the lab on work boat. Self-contained mobile lab could be rapidly transported to site of nearly any spill.

6. Applicable Oil Type:

Study would be appropriate for any type of oil spill.

7. Time Frame:

Standard acute toxicity test would require a 96-hour exposure period (i.e., to estimate the 96-h LC50 for the oil and the oil-dispersant mixtures). However, since the time will be critical, it may be necessary to shorten exposure to 24 or 48 hours.

8. Cost:

Costs would not be related to spill size but would be determined by number of days lab and ship are on site. Costs for lab and personnel on site for 1 week could approach $10K exclusive of cost of ship time and collecting operations which could be shared with the research projects of other investigators.

9. Equipment Needs/Equipment Available:

Equipment needed would include: mobile lab with the appropriate exposure aquaria, diluters, pumps, and ancillary equipment normally required for bioassays (pH meters, dissolved oxygen meters, etc.). Bionomics currently operate mobile laboratory facilities which contain all the necessary equipment. Also required is test animal collecting gear such as trawl nets and water samplers.

10. Facility Needs/Facilities Available:

Facilities include mobile lab described above and work boat of appropriate size to transport lab.

11. Personnel Needs/Personnel Available:

Personnel required would include investigators familiar with the performance of on-site toxicity tests. Bionomics has personnel available with the relevant field and lab experience. Contact is S.R. Petrocelli 617/295-2550.

12. Support Services:

Support would include collection of test organisms and chemical analyses of water and animal tissues.

13. Payoff:

Results of study would (a) determine acute toxicity of the oil under field conditions to natural indigenous species; (b) give the OSC information regarding the selection of dispersant to be used in cleanup or allow the OSC to determine that a dispersant should not be used; and (c) using mortality as the criterion of effect, the economic loss associated with the death of a certain percentage of the species of interest could be determined.

The study would also allow the investigator to (a) determine impact on test animals of environmentally realistic oil concentrations; and (b) alter systems as required by the particular spill. That is, test under continuous exposure to oil as occurs during continuous release of oil from grounded tanker or test under pulse-dosing conditions as occurs if oil spill is intermittent. Also allows the study of under time-dilution conditions which occur once the input of oil into the sea is ended and the oil disperses with time.

14. Limitations:

Study would be difficult under conditions of heavy seas, strong winds, heavy ice conditions. Need to locate appropriate control areas from which to collect test animals. Test would probably be shortened in time and scope due to need for immediate information for the OSC to make decisions.

PANEL: LABORATORY TOXICITY
PROJECT NO.: 5
PRIORITY RANK:

1. Project Title: Time Dilution Bioassay on Holoplankton and Meroplankton

2. Project Description:

Objective of this study is to utilize actual spill dispersion information to assess the acute, latent and chronic impact upon selected species of marine holoplankton and meroplankton. Actual time series of chemical analysis from the spill site will be used to develop a dispersion model for continuous flow dosing system. Laboratory spawned or cultured organisms will be exposed using a design that will permit assessment of acute, latent and sublethal effects. Parameters could include embryological development, viable hatch, survival, and swimming behavior. For chronic studies on growth, reproduction, brood size and subsequent F_1 survival, this study will permit a realistic assessment of impact to the water column environment. Applications should be carefully chosen.

3. Performing Organizations:

Would include EPA-Narragansett, EG&G, Marine Research Associates.

4. Applicable Habitats:

This assay is applicable to pelagic habitats either nearshore or offshore.

5. Applicable Conditions:

Conditions for the success of this study include:

A. Detailed field analytical data and time dispersion model

B. Detailed lab analytical data to verify lab dosing systems

C. Application of assay in situations of known high potential impact. Spawning areas for ichthioplankton species, important meroplanktons, etc.

D. Deep offshore habitats where benthic impact is not expected.

6. Applicable Oil Type:

Oil type most applicable is one with high dispersability and potentially high WSF:No. 2, gasoline, No. 4.

7. Time Frame:

Acute and latent studies relate to temperatures and developmental periods of appropriate species, generally, 10 to 30 days. Chronic studies could extend to 60 days.

8. Cost:

Cost per assay: Acute with latent 100 to $200/assay; chronic $5 to $10K.

9. Equipment Needs/Equipment Available:

Dosing system ready to go with little advance notice.

10. Facility Needs/Facilities Available:

Facilities include analytical laboratory and bioassay facilities including flowing seawater, air and seawater temperature control, model ship for dosing system fabrication.

11. Personnel Needs/Personnel Available:

Reputable contractors available and federal research facilities.

12. Support Services:

Support services include analytical chemistry, culture of test species, field collection of indigenous adult spawning stock, biogeographical and seasonal information for proper species selection.

13. Payoff:

Produces hard scientific data based upon field observations and predictability for acute, chronic and latent effects. Verified (?) by field studies. Economic liability can only be assessed if data is model with historical catch, fecundity and year class data if available.

14. Limitations:

Limitations are that the plankton may constitute a minor problem due to patchiness, immigration and high reproductive potential.

PANEL: LABORATORY TOXICITY
PROJECT NO.: 6
PRIORITY RANK:

1. Project Title: Sublethal Effects of Chronic Exposure to Low Levels of Petroleum Hydrocarbons in Zooplankton (Coastal, Offshore, etc.). "This Work Could Also be Extended to Fish (Herring) or Other Crustaceans."

2. Project Description:

   A. Objectives: to determine the long-term effects of realistic, sublethal concentrations of petroleum oils on

      (1) rates of uptake and retention of hydrocarbons by above organisms.

      (2) rates of biodeposition of oil residues in fecal pellets.

      (3) rates of ingestion, assimulation and respiration.

      (4) energy available for growth, growth rates and fecundity.

      (5) interpretation in terms of their usefulness in predicting ecological influences of oil.

   B. How carried out?

      (1) populations of marine organisms will be held in 5700L tanks into which a continuous supply of seawater, food and oil is maintained.

      (2) physiological measurements will be done using organisms from the experimental (oiled-WSF) tanks and compared to control (unoiled).

      (3) possible results-reduction in carbon flow (Gilfillan, 1976), increased sensitivity to environmental stress, reduced fecundity.

3. Performing Organizations:

Bowdoin College Marine Research Laboratory and Bowdoin College Dept. of Chemistry. Personnel: Drs. Dana Mayo, Davie Page, Edward Gilfillan, Ray Gerber, all at B.C.

Address: Bowdoin College Marine Research Laboratory
Brunswick, Maine 04011 207/725-8731 Ext. 604

4. Applicable Habitats:

Coastal, Inshore, and Offshore waters of the Gulf of Maine.

5. Applicable Conditions:

Conditions for the study will be created and maintained using the flow-through dosing apparatus. Once the system is set up work can begin immediately.

6. Applicable Oil Type:

All oils can be used but should be limited to the most detrimental types.

7. Time Frame:

This is a long term study and the period reflects the length of the life cycle of the organisms and the seasonal cycle of food supply. We envision at least one full year studies, sampling once a week for nutrients, etc., bi-weekly for physiological studies, etc.

8. Cost:

1st year is $126K (includes cost of apparatus)
2nd year is $80K (salary and maintenance--H-C sample analysis)

9. Equipment Needs/Equipment Available:

A. flow through apparatus - to be constructed

B. H-C equipment available at Bowdoin College

C. physiological equipment--mostly available: respirometers, feeding apparatus, glassware, balances, etc.

D. CHN analyses--not available at Bowdoin College but from Bigelow Laboratories, Boothbay Harbor, Maine.

10. Facility Needs/Facilities Available:

A. We have no facility needs except for the building of the flow-through apparatus.

B. Chemistry Dept., Marine Research Laboratory at Bowdoin College has adequate space at the Main Campus and the marine laboratory at Bethal Point.

C. Boats available for collecting and computer, library facilities excellent.

11. Personnel Needs/Personnel Available:

A. Chemistry group--Drs. Dana Mayo, David Page

B. Marine Research Group--Drs. Edward Gilfillan, Ray Gerber.

These personnel have had extensive experience in their respective fields.

C. Two technicians--S. Hansen and J. Cooley; both senior technicians.

12. Support Services:

A. Nutrient samples and particulate carbon and nitrogen samples can be processed at the Bigelow Laboratories (they have approved this work).

B. No other support services necessary.

13. Payoff:

A. This work will determine the long-term effects (physiological) of sublethal concentrations of petroleum H-C on marine organisms using a flow-through in situ system.

B. We are concerned with nutritional physiology and energy flux which ultimately effects the production of these populations.

C. Provide insite into H-C uptake, rate of retension and ultimately the concentration and movements of these H-Cs up the food chain...even to man.

D. Any reduction in the production at one level (e.g., zooplankton) could affect abundances by reducing consumer populations (herring, etc.).

E. Since these experiments will be conducted throughout the year, valuable information on temperature and food effects on the organisms' ability to resist oil pollution will be obtained.

F. The flow-through apparatus will provide more realistic conditions compared to static systems and could be used in other similar dosing studies.

G. Economic payoff would be directly related to possible reduction in the growth and production of economically important species.

14. Limitations:

A. The experiments have to be long-term and require considerable manpower, thus would be costly and time consuming.

B. Each apparatus ($25K each) can only work with one oil type at a time.

C. Results from these studies will not be directly comparable to studies from "static systems."

D. The complexity of the apparatus will no doubt create operational problems, which should be overcome after the first year of operations.

E. The system may have to be closed down (December-February) because of severe weather conditions in Maine.

PANEL: LABORATORY TOXICITY
PROJECT NO.: 7
PRIORITY RANK:

1. *Project Title*: Effects of Oil Tainting of Prey on Food Selectivity and Feeding Behavior of Two Predatory Fish Species

2. *Project Description*:

A. Objectives

(1) Determine behavior effects of an inshore oil spill on normal feeding behavior of two predatory fish species in terms of alteration of prey palatability.

(2) Increase knowledge in defining biologically adequate stimuli used for optimal prey selection in fish, and observe how these stimuli are altered by oil tainting.

(3) Determine the "rejection strength" of oil-tainted prey in relation to feeding motivation changes due to satiation.

B. Materials and Methods

Predator and prey species will be chosen with careful consideration of constraints involved in a laboratory study, i.e., predator and prey species suitability for laboratory holding facilities; availability of normal prey in a spill site, etc. Feeding behavior studies indicate two preliminary predator species as plausible candidates. Olla et. al. (1975) found juvenile *Tautoga onitus* to feed primarily on *Mytilus edulis*. Olla et al. (1969) indicated adult winter flounder (*Pseudopleuronectes americanus*) to feed mainly on bivalve moluscs and gastropods. Juvenile winter flounder will be used, as Werner (1974) has predicted greater selectivity in juvenile fish due to restrictions of a smaller mouth gape. It is proposed here that these two predators, being important sport and commercial fish species, be utilized in behavior bioassays to determine effects of oil tainting on feeding response to normal prey (*Mytilus edulis*). Predators will be obtained from a clean site and held in the lab. Contaminated prey (*Mytilus edulis*) will be obtained from a spill area, and control prey from a "clean," uncontaminated area. Experiments will take place in sea water tables 1.5m^2 x 10cm deep. Predators will be presented with a choice situation of oil-tainted and uncontaminated prey simultaneously. Probability of eating prey items and response to the prey will be recorded. Data will be categorized into different motivation (satiation) levels and analyzed for differences between tainted and "clean" prey. This methodology has been used in behavior experiments by Kislalioglu (1976) to analyze stimulus cue strength of prey in fish feeding studies.

3. Performing Organizations:

EPA Environmental Research Lab In-House project.

4. Applicable Habitats:

Rocky shore and possibly offshore bottom (flounder).

5. Applicable Conditions:

Oil impact on a rocky intertidal area with adequate mussel beds impacted.

6. Applicable Oil Type:

Any heavy oil which would fulfill the above requirement.

7. Time Frame:

The study requires a 2 year period, consisting of review of gut analysis data in the literature; baseline feeding studies to define the relationship of satiation to feeding behavior in the species used and to define normal feeding responses; and oil studies to observe any changes in normal feeding response. Because of the dependence upon a spill of opportunity, baseline studies will proceed until a spill of the specified type occurs in the Region I coastal area, at which time emphasis will be shifted to oil studies, with return to baseline studies necessary for comparison of behavioral feeding responses.

8. Cost:

In-House Project 1040 App't. EPA ERL-Narragansett	$15K/man-years x 2 = $30K (includes use of EPA facilities and equipment)

9. Equipment Needs/Equipment Available:

Will be supplied by EPA ERL-Narragansett.

10. Facility Needs/Facilities Available:

Supplied by EPA ERL-Narragansett.

11. Personnel Needs/Personnel Available:

Christopher Deacutis, University of Rhode Island.

12. Support Services:

Body burden analysis of pooled oil-tainted prey.

13. Payoff:

A. Examines the effect of oil on normal predatory-prey relationships. Depending upon predatory species utilized, the project may offer some predictive abilities as to impact strength on generalist vs. more specialized predators. It is expected that those fish species which rely on chemosensory cues in any behavioral components of normal feeding behavior will be most likely to alter normal feeding behavior, and possibly result in "area avoidance searching" (Thomas, 1975). If a large area is impacted by the oil, extensive localized migration and avoidance of the impacted area may take place. Thus:

B. Contributes to long-term assessment of oil spill ecological damage in terms of loss of contaminated areas as adequate feeding grounds for commercially valuable fish species.

14. Limitations:

Prey should be obtained after cleanup if possible. A spring or summer spill is desired since most fish species depress feeding behavior to very low levels in winter months. If mussels are in offshore areas, diving services may be required.

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PANEL: LABORATORY TOXICITY
PROJECT NO.: 8
PRIORITY RANK:

1. Project Title: Effects of Oil-Spill Contaminated Sediment on Reproduction of Winter Flounder, *Pseudopleuronectes americanus* (Walbaum)

2. Project Description:

Objectives of the project would be:

A. To assess the impact of oil contaminated sediment on the reproductive success of winter flounder, as measured by larval survival after parental exposure during gonad maturation.

B. To investigate whether a similar response occurs in the field at an oil spill site by collecting gravid flounders from the site, obtaining gametes, and measuring larval survival.

3. Performing Organizations:

Environmental Research Lab. - Narragansett (EPA)

4. Applicable Habitat:

Shallow salt pond; worm-clam flat; shallow estuary or embayment.

5. Applicable Conditions:

A. Persistent incorporation of oil into the sediment

B. Existence of a suitable control site

C. Impact in an area where a spawning population of winter flounder resides.

6. Applicable Oil Type:

Any frequently transported oil which has potential for incorporation into sediment (preferably No. 2 fuel oil for comparison with previous studies).

7. Time Frame

One to two years although follow-up studies may extend this to five years.

8. Cost:

$20K-$30K (?)

9. Equipment Needs/Equipment Available:

- large tanks for adult exposure
- 10 gallon aquaria with temperature control
- sediment collection equipment
- 2 otter trawls
- plankton nets or a supply of plankton for larval food
- microscope.

10. Facility Needs/Facilities Available:

Analytical (GC) sediment and tissue analysis boat equipped for handling an otter trawl and willing to trawl in an oil contaminated area.

11. Personnel Needs/Personnel Available:

Diane Everich - Research Aquatic Biologist, EPA-ERL, Narragansett

One technician - part-time.

12. Support Services:

Completed sediment contamination surveys of spill area.

13. Payoff:

A. Study will indicate impact of an oil spill on winter flounder reproductive success.

B. Catch statistics plus fecundity information in literature may be combined with results from this study to produce a rough estimate of damage cost to winter flounder fishery.

14. Limitations:

A. Collection of sediment from spill site for laboratory exposures may be difficult due to patchy distribution of oil and disturbance of oil gradient in sediment during collection. This problem may be avoided by artificial contamination of sediment in the lab using the same oil which was spilled.

B. It may happen that flounders avoid the spill site, in which case the spill is not a problem -- an interesting result in itself.

PANEL: LABORATORY TOXICITY
PROJECT NO.: 9
PRIORITY RANK:

1. Project Title: Effects of Chronic Exposure to Oil on Representative Marine Animals

2. Project Description:

Exposure of marine animals to oil even for limited periods of time may result in significant deleterious effects on the subsequent growth, development and reproduction of these animals. Since it is difficult to determine the exposure history of animals collected in the field, laboratory populations of fish, crustaceans and/or molluscs could be exposed in the lab in a dynamic (flowing) water system to a range of concentrations representing different size oil spills in different water masses representative of open ocean versus coastal embayment, etc. Following exposure to the whole oils for a period of time approximating an oil spill (days, weeks or months) the oil source would be ended and the growth and development of the animals measured in terms of length and weight measurements; fecundity of animals exposed to oil at the various concentrations could be compared with each other and with the controls to determine a dose-response relationship and the subsequent hatching of eggs and development of larvae could be determined. During this time observations of behavior and physical anomalies could be made; subsamples would be removed for histopathological examination as well. This study would yield information concerning the long-term effects on marine animals of exposure to an oil spill in the field in a manner which would permit an evaluation of the potential decrease in populations of these species as a direct result of the exposure.

3. Performing Organizations:

EPA
Bionomics
EG&G

4. Applicable Habitats:

Any habitat could be considered.

5. Applicable Conditions:

It is necessary (a) to work with species which can be successfully cultured in the lab and (b) to determine prior to commencement of the study, the duration of exposure and oil concentrations to be representative of an actual oil spill.

6. Applicable Oil Type:

Any type of oil could be tested.

7. Time Frame:

Time frame depends on the duration of the life cycle of the animal being tested and could range from 17-20 days for the calanoid copepod *Scartia tonsa*, to weeks for the mysid shrimp *Cyprinodon vainegatus*.

8. Cost:

Size of spill does not affect cost. Cost determined by duration of life cycle (i.e., amount of time populations are to be maintained in lab following exposure). Costs may approach $75K for 7 months sheepshead minnow study.

9. Equipment Needs/Equipment Available:

Appropriate exposure aquaria, water quality measurement apparatus (pH and dissolved oxygen meters, GC, etc.).

10. Facility Needs/Facilities Available:

Facilities required would include a laboratory with flowing good quality seawater, water tempering equipment, analytical laboratories.

11. Personnel Needs/Personnel Available:

Investigators with familiarity with the general biology and culturing of the test species are preferred. Bionomics currently employs persons with the necessary qualifications. Contact S.R. Petrocelli 617-295-2550.

12. Support Services:

Analytical chemistry is most important ancillary service required.

13. Payoff:

Results of study would define the long term effects of oil spills on marine animals and perhaps permit an evaluation of the changes in numbers of individuals surviving and reproducing in natural populations.

14. Limitations:

By necessity, only one species could be tested in any study. Separate studies must be conducted with each of several significant species. It would be difficult to determine the overall ecological effects but does give good information for the selected species (which should be selected on the basis of commercial, ecological and human health significance).

SOCIOECONOMIC AND LEGAL ASPECTS PANEL

Participants

J. Praeger, Chairperson
P. Fricke, Co-Chairperson

C. C. Bates
S. Carroll
C. Carty
P. Cavicchi
R. Ceurvels
F. R. Disheroon
J. Fiske
D. Forcella
J. Gentile
C. Hall
J. W. Hurst
J. F. Kirkland
S. M. Lord
W. Marhoffer
J. Marotta
B. Melzian
F. C. Monastero
D. G. Neal
S. Peterson
R. Rehfus
R. Robinson
L. Slaski
W. Smith
J. Snider
J. Valenti
H. D. VanCleave
Judge T. Yost

SOCIOECONOMIC AND LEGAL ASPECTS PANEL

General Information and Guidance

- Initial Considerations
- Follow-Up Panel Activities

INITIAL CONSIDERATIONS

A. Formation of Socioeconomic Subpanel

The initial act of this panel was to recognize that the social sciences should contribute project proposals in their own disciplines to the Executive Committee. Consequently, a separate subpanel on assessment of socioeconomic impacts of an oil spill was created under the Chairmanship of Peter Fricke.

B. Legal Framework for Damage Assessment

1. Pending Legislation

The panel addressed applicable law and decided that the wisest course of action was to offer guidance based upon anticipated passage of one of the three laws now before Congress dealing with oil spills. This is possible because none of the three affect the nature or amount of scientific contribution to ecological damage assessment. All deal with traditional concepts of damage assessment, such as oil removal costs, losses of use, losses of profits, losses of tax revenues, etc. Only "loss or injury to natural resources" is a new feature of the law. This will need to be developed through the evolution of case law -- but is a major concern of this workshop.

2. The Three Questions

The basic questions that must be answered in a case in which damage to natural resources is claimed are:

1) What was damaged?

2) How much was it damaged?

3) How was it damaged?

Discussions of these questions elicited a recurring theme of baselines or controls. The panel concluded that although baseline or control information is highly desirable, it is not always available. Therefore, studies of damage must be prepared to proceed in the absence of prior or control data. Scientists must be prepared to determine what is measurable in the absence of a baseline -- and how this may be used in a forensic sense to establish answers to what was damaged, how much it was damaged, and by what means it was damaged.

3. Scientific vs Legal Requirements

Whereas science would like to be at least 95 percent sure of its ground before venturing an opinion, the courts are satisfied with 51 percent surety. Expert opinion is quite acceptable -- and the weight or preponderance of evidence sways the court's decision. Thus, narrative description of observable phenomena is adequate and acceptable if nothing more substantial can be developed as evidence.

FOLLOW-UP PANEL ACTIVITIES

A. Development of Legal Guidance for Scientists

The panel agreed that as an exercise, it would define the elements of an ideal case, and then determine just how far from the ideal each element could stray, before the study would be deemed useless. An ideal case of ecological damage assessment was defined as one in which:

1) All parties were defined.
2) A scientific baseline was available.
3) Damage was to a commercial crop.
4) Cause and effect of the spill was clearly demonstrable.
5) Economic losses were measurable.
6) Means of measurement were known, verified, and agreed upon.
7) Predictable losses of resources and their economic values were agreed upon.

Clearly this set of criteria never will be fully met. What then, can scientists contribute to the adjudication of these seven points?

Identification of the parties is not in the scientific realm. The parties will be determined by the courts. The remaining 6 criteria are fair game for the scientific community. The guidance to be developed by the panel will deal with such questions as:

- Do conditions under which samples are taken affect stringency of proof required?
- Can index species be used to presume baseline conditions?
- Must an effect on man be proven to demonstrate damage?
- Can scientific findings be prioritized in the legal arena?
- Must cause and effect be provable in every case?
- How much money is a dead barnacle really worth?

B. Specific Projects

The projects recommended by the panel represent broad brush, but not exhaustive proposals to gather information which would be useful in assessing socioeconomic impacts of oil pollution. It should be noted that any person or corporate entity earning more than 25 percent of his yearly income from marine related activities is entitled to redress if he can prove damage under proposed legislation (HR-6803). Thus, in addition to providing the OSC with information which would assist in the choice of cleanup methods, the socioeconomic studies are seen as providing yard sticks against which compensation for given incidents may be measured.

The suggested studies fall into two groups. Baseline studies are seen as providing basic information about socioeconomic activities which will probably be impacted by any spill. These studies would require periodic updating. The second group of studies provide specific information useful in impact assessment, but would not need to be updated. The actual impact studies after a polluting event would draw upon the two groups of research studies and would ascertain the impact in socioeconomic terms.

SOCIOECONOMIC AND LEGAL ASPECTS PANEL

Recommended Projects*

1. Overview of the maritime socioeconomic activities of the region by sub-region.
2. Baseline study of commercial fisheries processing industry by sub-region.
3. Baseline study of the fish processing industry by sub-region.
4. Baseline study of the fish trucking by regions and sub-regions.
5. Baseline study of fish retailing dependent upon locally caught fish by sub-region and region.
6. Baseline study of the recreational boating industry and of boat ownership and use.
7. Baseline study of sports fishing by sub-region.
8. Baseline study of recreational use of the shoreline.
9. Analysis of effectiveness of baseline research as a basis for assessing legal damage.
10. Analysis of the cost-effectiveness of oil spill cleanup operations.
11. Study of the socioeconomic factors involved in locating oil pollution response equipment stores and the designation of areas for beaching or off-loading damaged vessels.
12. Analysis of oil transportation patterns for the region by sub-region.
13. Development of models for the assessment of socioeconomic damage following spills.

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*Projects 1-8 are considered baseline studies providing basic socioeconomic information which would require periodic updating. Projects 9-14 provide specific information useful in impact assessment which would not require updating.

14. Assignment of socioeconomic priorities for protection of areas vulnerable to oil spills by sub-region.

15. Preliminary descriptions of additional projects.

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 1
PRIORITY RANK:

1. Project Title: Overview of the Maritime Socioeconomic Activities of the Region by Sub-Region (A sub-region is defined as one bounded by natural features of the marine environment, e.g., Narragansett Bay or Vineyard Sound.)

2. Project Description:

   Goals of the project would be:

   A. Ascertain population size, demographic characteristics, and distribution by season;

   B. Provide a general description of the human use, and economic value of the marine environment by region and sub-region;

   C. Provide a full description of the industrial uses of the marine environment (e.g., sand and gravel extraction, shore line industrial sites, ports and terminals);

   D. Identify the fisheries and their socioeconomic values;

   E. Identify other uses of the marine environment and their socioeconomic values;

   F. Identify areas and uses particularly vulnerable to oil pollution;

   G. Provide a comprehensive reference to previous experience in coping with oil spills and cleanup.

3. Performing Organizations:

   State Coastal Zone Management (CZM) Offices; University of Massachusetts; University of Maine; University of Rhode Island (URI); Southeastern Massachusetts University (SMU); MIT; Woods Hole Oceanographic Institution (WHOI), EG&G, Northeast Marine Environmental Institution; Temple, Barker and Sloane, Inc.

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

   1 year; updated quinquennially.

8. Cost:

   $80,000 initially; $20,000 for updates.

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

    The study will provide an overview of socioeconomic activities in the region and will pinpoint areas of particular impact for later studies.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 2
PRIORITY RANK:

1. Project Title: Baseline Study of Commercial Fisheries by Sub-Region

2. Project Description:

Goals of the project would be:

A. Collate catch statistics by species, by location of catch, by value on landing at the dock.

B. Provide data on the number of vessels and fishermen using the sub-region as

(1) a base for operations

(2) regular fishing activity

C. Examine structure of industry (e.g., company or family ownership of vessels; part or full-time fishing activities; whether subsistence or purely commercial fisheries).

D. Investigate capital employed in the industry (value, age and size of vessels, gear, etc.).

3. Performing Organizations:

NOAA/NMFS; New England Fishery Management Council (NEFMC); WHOI (Dr. Peterson and Dr. Smith); URI (Drs. Poggie and Norton); University of Maine (Dr. J. Atcheson) EG&G (Mr. Henry Cygan). (N.B. Dr. Peterson is completing a baseline study for the NEFMC; Drs. Poggie and Atcheson have a newly awarded contract from NSF for a regional study.)

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

2 year initial study; 1 month annual updates.

8. Cost:

$300,000 initially; $12,000 annually.

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

Full assessment of probable socioeconomic impacts on the fishing industry.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 3
PRIORITY RANK:

1. Project Title: Baseline Study of the Fish Processing Industry by Sub-Region

2. Project Description:

   Goals of the project would be:

   A. Provide fish product statistics by species, source and value;

   B. Indicate the number of plants and employees, and the size and value of the operations;

   C. Indicate the structure of the industry for each sub-region (e.g., whether frozen or fresh fish are used; degree of vertical integration with associated industries; company or family plant-ownership; whether seasonal, part or full-time operation in normal practice);

   D. Capital structure of the industry (age, value and type of equipment, etc.);

3. Performing Organizations:

   WHOI (Dr. Peterson and Dr. Smith); URI (Dr. Norton); SMU (Dr. Giorgioni); University of Maine (Dr. Wilson); University of Massachusetts-Amherst (Dr. Storey) EG&G (Mr. Henry Cygan). (N.B. Drs. Peterson and Smith are currently working on a similar study.)

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Types:

7. Time Frame:

   1 year initially; 2 weeks annual update.

8. Cost:

   $40,000 initially; $6,000 annually.

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

    Indication of the probable impacts of oil pollution on the fish processing industry.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 4
PRIORITY RANK:

1. Project Title: Baseline Study of Fish Trucking by Regions and Sub-Regions

2. Project Description:

   Goals of the project would be:

   A. Mapping of fish distribution networks;

   B. Detail the numbers of trucks and persons solely involved in the transportation of fish;

   C. Show the structure of the industry (e.g., whether company or individually owned trucks; the degree of vertical integration, etc.);

   D. An analysis of the capitalization of fish truckings (e.g., value, age and type of trucks; whether owned or leased, etc.).

3. Performing Organizations:

   University of Massachusetts (Storey)
   WHOI (Peterson and Smith)
   EG&G (Cygan and Strack)

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

   Three months initially; update 1 week annually (this could be associated with the update of fish processing).

8. Cost:

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoffs:

Provide an estimate of an industry which would be affected if oil pollution caused a shift in fishing grounds and landing ports.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 5
PRIORITY RANK:

1. Project Title: Baseline Study of Fish Retailing Dependent Upon Locally Caught Fish by Sub-Region and Region

2. Project Description:

Goals of the project would be:

A. Provide an analysis of the sources of fish supplied, their quantity and value, and the local market area served;

B. A mapping of the number of markets/stores and persons engaged in the industry by season;

C. An analysis of the structure of the industry (e.g., degree of vertical integration with other aspects of the fishing industry; whether company or family owned, etc.);

D. Capital structure of the retail system (e.g., value, age, and type of store, equipment, etc.).

3. Performing Organizations:

University of Massachusetts-Amherst (Storey)
URI
WHOI (Peterson and Smith)
EG&G (Cygan and Strack)

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

Four months initially; quinquennially update of 2 weeks.

8. Cost:

$20,000 initially; $2,500 for updates.

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

An assessment of the structure of a local industry which would be quickly affected of local supplies if fish were tainted or fishing grounds closed.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 6
PRIORITY RANK:

1. Project Title: Baseline Study of the Recreational Boating Industry and of Boat Ownership and Use

2. Project Description:

Objectives of the project would be:

A. Description of the size, numbers and location of recreational boating facilities--marinas, boatyards, boat ramps--both public and private, their degree of use and spatial distribution;

B. Values, numbers and types of boats by region and sub-region;

C. Socioeconomic profiles of boat owners and patterns of use of their craft;

D. Capital structure of marinas (e.g., ownership patterns, value and size of facilities, equipment, etc.);

E. Capital structure of boatyards (e.g., ownership patterns, value and size of facilities, equipment, etc.).

3. Performing Organizations:

State CZM Offices
URI (Dr. Rorholm)
MIT (Dr. Devanney)
WHOI (Peterson and Smith)
SMU
University of Maine
EG&G (Cygan and Strack)

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

9 months.

8. Cost:

$30,000.

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

Identification of patterns of recreational boating facilities use for OSC planning, and the impact of oil pollution in sub-regions.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 7
PRIORITY RANK:

1. Project Title: Baseline Study of Sports Fishing by Sub-Region

2. Project Description:

Objectives of the project would be:

A. Description of size and location of fishing areas, their degree of use and the species sought;

B. Description of the numbers of fisherman engaged in off-shore, near-shore and on-shore sport fishing; a demographic profile of sports fisherman, and a socioeconomic appraisal of the number, size and types of boats and gear used;

C. Size, location and extent of charter boat operations, bait shops and services provided in local communities;

D. Capital structure of service sector.

3. Performing Organizations:

NOAA/NMFS
State CZM Offices
URI (Dr. Rorholm)
WHOI (Drs. Peterson and Smith)
EG&G (Cygan and Strack)

(N.B. NOAA/NMFS already conducts a survey of sports fishing which could easily be expanded to meet the needs of the baseline study.)

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

1 year; updated quinquennially.

8. Cost:

Initially $60,000; updates $60,000

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

    Provides a basis for the assessment of damage to sports fishing.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 8
PRIORITY RANK:

1. Project Title: Baseline Study of Recreational Use of the Shoreline

2. Project Description:

Objective of the project would be:

A. Ascertain size and location of shoreline amenity areas (e.g. beaches, salt water ponds, marshes, coastal trails, town wetland areas) and size of population served;

B. Determine types of use and social profiles of users;

C. Determine types of facilities, whether public or private, and the type and value of equipment provided.

3. Performing Organizations:

State CZM Office
University of Massachusetts-Amherst (Storey)
URI (Rorholm)
WHOI
SMU
University of Maine
University of New Hampshire
EG&G (Cygan and Strack)
Northeast Marine Environmental Institution

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

6 months initially; one month quinquennial update.

8. Cost:

$30,000 initially; $6,000 for updating.

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

Assessment of value to user population.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 9
PRIORITY RANK:

1. Project Title: Analysis of Effectiveness of Baseline Research as a Basis for Assessing Legal Damage

2. Project Description:

Objectives of the project would be:

A. To compare the costs of baseline and post-spill research with assessment of damages awarded by courts.

B. To ascertain the usefulness of information generated in research projects in the assessment of damages.

3. Performing Organizations:

University of Massachusetts
URI
SMU
WHOI
EG&G (Cygan and Strack)

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

3 months duration after legal proceeding completed. (The frequency of such studies would be determined by the RRT).

8. Cost:

$20,000

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Needs:

13. Payoff:

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 10
PRIORITY RANK:

1. Project Title: Analysis of the Cost-Effectiveness of Oil Spill Cleanup Operations

2. Project Description:

   Objectives of the research would be:

   A. Analysis of the cost components of cleanup operations and the effectiveness of these operations.

   B. Identify the cost benefit of cleanup operations required under the National Contingency Plan.

   C. Review these costs and cost benefits in relation to socioeconomic impacts observed.

3. Performing Organizations:

   USCG
   EPA
   State CZM Offices
   University of Maine
   University of Massachusetts
   URI
   SMU
   WHOI
   EG&G
   Northeast Marine Environmental Institution
   Temple, Barker and Sloane, Inc.

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

   3 months

8. Cost:

   $30,000

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

Input to the review of the national and regional plans.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 11
PRIORITY RANK:

1. Project Title: Study of the Socioeconomic Factors Involved in Locating Oil Pollution Response Equipment Stores and the Designation of Areas for Beaching or Off-Loading Damaged Vessels

2. Project Description:

   Objectives of the project would be:

   A. Establish criteria for the designation of "refuse" areas including public and private use, economic and social values of the areas.

   B. Assess alternative sites proposed by USCG.

3. Performing Organizations:

   State CZM Offices
   University of Maine
   University of Massachusetts
   URI
   WHOI
   EG&G
   Northeast Marine Environmental Institution

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

   3 months.

8. Cost:

   $25,000

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

Avoidance of additional socioeconomic impact from spilled oil mitigation procedures.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 12
PRIORITY RANK:

1. Project Title: Analysis of Oil Transportation Patterns for the Region by Sub-Region

2. Project Description:

Objective of the project would be:

A. Review movement of oil to and from regional ports, and through the seaways of the region, by type and quantity of oil carried and the type and size of vessel;

B. Identify areas of greatest density of oil movements.

3. Performing Organizations:

USCG
NOAA
State CZM Offices
University of Maine
University of Massachusetts
URI
WHOI
EG&G
Northeast Marine Environmental Institution
Temple, Barker and Sloane, Inc.

(N.B. A study of traffic off Maine, New Hampshire, Massachusetts and Rhode Island has been sponsored by NOAA and is being completed by WHOI.)

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

3 months.

8. Cost:

$25,000

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

Identification of vulnerable areas and types of threat to the environment.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 13
PRIORITY RANK:

1. Project Title: Development of Models for the Assessment of Socioeconomic Damage Following Spills

2. Project Description:

   Objectives of the project would be to:

   A. From the overview and baseline studies develop criteria to be used to assess damage;

   B. Develop an assessment plan for application to specific spills.

3. Performing Organizations:

   EPA
   NOAA
   State CZM Offices
   University of Maine
   University of Massachusetts
   URI
   WHOI
   EG&G
   Northeast Marine Environmental Institution
   Temple, Barker and Sloane, Inc.

4. Applicable Habit:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

   3 months; update after response experience at the request of RRT.

8. Cost:

   $25,000 initially.

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13. Payoff:

Standardization of assessment procedures.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS
PROJECT NO: 14
PRIORITY RANK:

1. Project Title: Assignment of Socioeconomic Priorities for Protection of Areas Vulnerable to Oil Spills by Sub-Regions

2. Project Description:

   Objective of the project would be to:

   A. Develop socioeconomic criteria for protection of specific sites;

   B. Develop, in conjunction with State and local governments, designations of priority in each sub-region.

3. Performing Organizations:

   State CZM Offices
   Regional University and Institutions
   Northeast Marine Environmental Institution

4. Applicable Habitat:

5. Applicable Conditions:

6. Applicable Oil Type:

7. Time Frame:

   3 months.

8. Cost:

   $25,000

9. Equipment Needs/Availability:

10. Facility Needs/Availability:

11. Personnel Needs/Availability:

12. Support Services:

13: Payoff:

Advice to OSC and States on protection of sites to be used in specific sub-regions.

14. Limitations:

PANEL: SOCIOECONOMIC AND LEGAL ASPECTS

Preliminary Descriptions of Additional Projects*

1. Analysis of the costs of Federally authorized cleanups (FWCTA Act of 1970).

   Description of research tasks:

   a) Size of spill and nature of oil;
   b) Size of cleanup area;
   c) Duration of cleanup;
   d) Extent of personal property affected;
   e) Cost of cleanup of various types of property;
   f) Degree of success of cleanup.

2. A study of the nature of commercial insurance adjuster's manuals for determining injury to, destruction of, or loss of use of:

   a) real property;
   b) personal property;
   c) natural resources;
   d) income/earnings.

   Research Objective: Develop a similar set of predictions for use by assessors in oil spill cases.

3. A national compendium of insurance and legal specialists experienced in oil spill litigation.

   Description of research objective:

   Establish, for the benefit of the public, the damage assessment panels and administrative judges, a roll of those with particular experience in oil spill litigation and the assessment of property damage and economic loss rising therefrom.

4. A summary of the operation of the international TOVALOP and CRISTAL funds in paying for oil spill damages.

5. A study of international practices in assessing cleanup and damage costs for oil spills, and in providing reimbursements.

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*These projects were proposed but full discussion of them was not accomplished.

Description of research objectives:

Develop comparative case studies of the methods used in oil pollution cases in Japan, Norway, France and the United Kingdom for possible use in standard setting.

6. Compilation of a digest or handbook on the variability in natural resources, particularly those of commercial value, and their use and the causes of such variability.

Description of research objectives:

Provide a guide to lawyers, panels of assessors and administrative judges in interpreting standard regulations and assessment.

FACILITIES AND DATA MANAGEMENT PANEL

Participants

C.L. Eidam, Chairperson

R. Boynton
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A.R. Ceurvels
J. Fiske
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G.F. Kelly
D. Kennedy
M. Lockwood
W.J. Marhoffer
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FACILITIES AND DATA MANAGEMENT PANEL

- Guidelines and Criteria for Facilities
- Data Management Aspects
- Research Vessels in EPA Region I
- EPA Region I Chain of Custody Procedures

GUIDELINES AND CRITERIA FOR FACILITIES

A. Reporting Format for Facilities

Initial order of business centered around a review of the guidance prepared for the panel by the Chairman and deciding on a course of action which the panel would follow to fulfill its objectives. After a fairly lengthy review, it was accepted by the panel as a workable document. The panel then focused on the specific criteria which would be used to fulfill the guidance document. The remainder of the session was spent defining these criteria into a workable reporting format for inclusion in the workshop report.

In developing this reporting format, the panel considered two basic scenarios: (1) emergency scientific support to the On-scene Coordinator (OSC) and (2) longer term (or after-the-fact) environmental assessment studies. The reason for this delineation centered mainly around the availability of funding for emergency OSC support through the Federal revolving fund, and the present lack of dedicated funds for longer term studies. The first topic covered was fixed and mobile laboratory facilities. The panel initially separated this topic into two groups, but after considerable discussion, the panel felt that mobile laboratories are essentially a support function of fixed laboratory facilities and, therefore, decided to identify mobile labs as a support category under fixed laboratories.

The following is an outline of the reporting format which was agreed on by the panel to describe fixed laboratories facilities in accordance with the guidance document.

1. Fixed Laboratories
    a. Location

b. Operating Organization

c. Contact Person: Name, Bus. tel., 24-hour tel.
Alternate: Name, Bus. tel., 24-hour tel.

d. Capabilities

   (1) Physical Oceanography

   (2) Biological Oceanography

   (3) Chemical Oceanography

   (4) Geological Oceanography

   (5) Current Research/Operational Activities

   (6) Maximum Sample Output (1 day, 1 week, etc.) by category of hydrocarbon analysis, oil identification, etc.

   (7) Mobile Laboratory

e. Availability

   (1) Emergency Support - categorize high or low

   (2) Longer Term Studies - categorize high or low

A number of issues were discussed in arriving at this reporting format. Most notably, the issue of funding and analytical costs was at question. It was the concensus of the panel, based on advise from Coast Guard representatives, that funding of emergency support services to the OSC was available through the Pollution Revolving Fund, and, therefore, was not a constraint. While this is true if the fund is activated, there will be a number of incidents in which the responsible party will be taking proper cleanup actions, thus not allowing use of the fund at times during which the OSC might still need scientific support. In these cases, the considerations pertinent to longer term studies will apply.

This panel recognized that the availability of laboratories for longer term studies would be dependent on a number of factors. Federal laboratories, for example, might be willing to undertake longer term studies if they fell within the criteria of already funded research activities. The availability of private laboratories, however, would probably be based on the results of bid invitations and the acceptance of some form of basic ordering agreements (BOA) for the specific projects required.

2. Command/Coordination Centers

The NOAA-SOR Team has established operating guidance which includes criteria for command/coordination centers. This document was made available to the panel by the SOR Team director. If possible, identical or similar criteria will be used by the panel to ensure maximum compatability.

3. Fixed Wing Aircraft

The following criteria were established by the panel to describe fixed wing aircraft.

a. Aircraft Type

b. Operating Organization

c. Contact Person: Name, Bus. tel., 24-hour tel.

d. Alternate: Name, Bus. tel., 24-hour tel.

e. Remote Sensing Capability

f. Range

g. Load and Passenger Capacity

h. Navigation Capability

i. Operating Costs

j. Other Capabilities: e.g., over water, water landing capability

4. Rotary Wing Aircraft

The same criteria as applied to fixed wing aircraft apply to rotary wing aircraft.

5. Nearshore Oceanographic Vessels

These were subdivided by the panel into short endurance work platforms (i.e., no overnight capabilities) and longer endurance nearshore craft. The following criteria will be used to describe these vessels.

a. Ship Type

b. Operating Organization

c. Contact Person: Name, Bus. tel., 24-hour tel.

d. Alternate: Name, Bus. tel., 24-hour tel.

e. Range

f. Endurance

g. Sampling Capabilities - Including fish and plankton travels, benthic sampling (both geological and biological) water column sampling, instrument emplacement and meteorological capabilities.

h. Scientific Party Capacity

i. Draft

j. Navigation Capability

6. Offshore Oceanographic Vessels

Same as a-j above. Other capabilities - include satellite support (i.e., work boats, helicopter landing and refueling capabilities, etc.).

7. Radio Communications

a. Operating organization

b. Location

c. Contact Person: Name, Bus. tel., 24-hr tel.

Alternate: Name, Bus. tel., 24-hr tel.

d. Frequency assignments - other frequencies available.

e. Types of Equipment: Base, mobile, hand held

f. Range

(1) Base - mobile

(2) Base - hand held

        - (3) Mobile - hand held
    - g. Equipment Available
        - (1) Base
        - (2) Mobile
        - (3) Hand held
    - h. Availability
    - i. Daily Time of Operation
    - j. Mobile Operator Interface - yes, no

Land line communications, including telephone and TWX/TELEX capability will also have to be inventoried for all participating organizations.

8. Submersible Criteria

The following criteria were established for submersibles:

1) Vessel Name

2) Operating organization

3) Location

4) Contact person: Name, bus. tel, 24-hr tel.
Alternate: Name, bus. tel, 24-hr tel.

5) Depth capability

6) Sensing/sampling capability

7) Speed

8) Endurance

9) Surface Support Requirements

10) Transportability

11) Scientific compliment

12) Lock-out capabilities

13) Operating Costs

14) Availability

15) Communications

16) Navigational capability

17) Safety equipment

B. Funding for Facilities

The panel discussed various alternative mechanisms which might be utilized to fund the use of facilities. It was recognized that the normal contracting procedures used by the Federal Government are much too lengthy to be effectively utilized to fund private sector response. The panel, therefore, recommends that the following mechanism be investigated by the executive committee as possible funding means:

- Basic ordering agreements (BOA'S)
- Letter contracts
- Procedures used by the Coast Guard for funding clean-up contractor emergency response.

The use of interagency agreements was felt to be a viable method of transferring funds among Federal agencies for reimbursement of facility costs, if needed. It was recognized, however, that all Federal agencies have statutory responsibility for oil spills, and, therefore, should be encouraged to commit their own resources to this problem.

C. Follow-up Work on Facilities

The panel agreed that it could go no further in its work until specific information is obtained from all participating organizations. The Chairperson, therefore, relieved the panel of any further responsibilities. The Chairperson will now begin to gather specific information required to complete our work. To date, the following organizations have submitted facilities data: University of Rhode Island, EG&G, Jackson Estuarine Lab (UNH), USGS, USCG, ERCO, NOAA-SOR.

DATA MANAGEMENT ASPECTS

A. General Considerations

The success or failure of any scientific endavor can only be assessed by the quality of the data gathered and the mechanism by which the integrity of these data is maintained throughout the time period required for initial assessment of the problem until the data is deposited in a national archive. Data quality can be assured by adapting valid procedures, utilizing proper techniques, etc. Data integrity can only be assured through an adequate data management system. This system can be as simple as using a set of 3 x 5 cards to track the data from the time it is collected until it reaches its final "resting place," or it could be a sophisticated computerized system as is currently being used for the NOAA/BLM OCSEAP program in Alaska.

B. Data Management and Chain of Custody

This plan shall be an integral part of the proposed organization of the scientific response program and, as such, shall include within its framework the necessary elements of its "chain of custody" procedure to insure legal sufficiency of data collected.

As proposed, a data management plan at a minimum should include the following elements:

1. A predesignated data coordinator. This could be the EPA or NOAA scientific coordinator (be it nearshore or offshore) or an assistant at that level. This individual will:

    a. Respond immediately in support of the response team to regional spills for the purpose of implementing the data tracking and chain of custody procedures.

    b. Interact with all NOAA components and contractors to ensure that data tracking and necessary chain of custody procedures are carried out.

    c. Act as a sample transfer mechanism when ship returns from cruise. This will insure consistency in chain of custody procedures as well as insuring integrity of collected data.

d. Act as a training officer to brief staff and contract personnel on the necessity of chain of custody and data handling procedures and will be a local source of chain of custody materials.

2. Adoption of an existing data tracking system as well as archival formats for all oil spill environmental investigations. As an initial proposal, the tracking system and its archive formats developed for the BLM/OCSEAP could be used. It appears that the data management approach taken for OCS investigation could be satisfactory for this purpose.

3. Designation of a national repository to store and disseminate the data upon completion of its field project.

These are four main points to emphasize in this plan:

- A data/chain of custody coordination must be identified prior to a spill.
- Adoption of a data tracking system
- Predesignation (if available) of formats for which data shall be reported.
- Designation of a national repository.

The Environmental Data Service (EDS) of NOAA has a field liaison officer at Region I (Woods Hole) with extensive knowledge, contacts and experience in data management. This individual shall act as a focal point for data management activities as well as serve as a consultant in data management matters to the damage assessment team leader.

In addition, this office is prepared to supply to its scientific support team information, the availability of necessary baseline enviornmental information (data/literature) in the area of the spill. Other services available through this office are access to the Environmental Data Base Director which will identify other types of data which has been collected in the area of the spill.

RESEARCH VESSELS IN EPA REGION I

The following pages identify research vessels available in the New England Region categorized in three groups; offshore vessels, near-shore long endurance vessels (e.g., remain at sea more than one day), and nearshore short endurance vessels. The listing is based on a 1974 UNOLS inventory and the oceanographic vessel listing in the 1976 Sea Technology Handbook, supplemented by information submitted at the Hartford Workshop. Some information may be outdated or incorrect. Therefore, appropriate persons are requested to verify and complete information on those vessels listed and to identify vessels not listed by using the blank forms at the end of each vessel grouping.

OFFSHORE VESSELS

U. S. ENVIRONMENTAL PROTECTION AGENCY
Region I - Research Vessel Inventory

Vessel Name (yr. built) ALBATROSS IV (1962) Home Port WOODS HOLE, MA

Operating Institution:
NOAA/NMFS
WOODS HOLE, MA

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 187' Beam 33' Draft 16'
Displ. Tons 1,089 Cruising Speed 11
Machinery DIESEL H.P. 1,000
Type Hull/Material
Accommodations:

	Crew	Scientists
Day Cruise		
Overnight	23	13
Ext. Cruise	23	13

Endurance:
Days Miles 9,000
Usual Areas of Operation:

Lab Spaces (Describe) CHEMICAL, HYDROGRAPHIC, ELECTRONIC, BIOLOGICAL (2)
Electric Power:
K.W. 150, 60 Volts 120/240 [✓ AC]/DC
Winches: TRAWL (2) DREDGE HYDRO (2)
Wire Size
Length
H. P.
Booms/Cranes:
Type Cap
"A"-Frame

Echo Sounder Precision Recorder
Nav. Equipment
Describe any special vessel capabilities ELECTRIC BOW THRUSTER
Vessel available for outside use? What Basis?
Cost: Per day Per week Other
Areal limits of operation
Other comments

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) R/V ATLANTIC TWIN (1965) Home Port STATEN ISLAND, N.Y.

Operating Institution:
OCEAN/SEISMIC/SURVEY
OAK STREET
NORWOOD, NEW JERSEY 07648

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 90' Beam 28' Draft 6' 6"

Displ. Tons 103 Cruising Speed 10 KTS

Machinery DIESEL (2) H.P. 456

Type Hull/Material CATAMARAN/STEEL

Accommodations:

	Crew	Scientists
Day Cruise	—	—
Overnight	4	10
Ext. Cruise	4	10

Endurance:

Days 20 Miles 4000

Usual Areas of Operation:

Lab Spaces (Describe) 10' X 18' IN DECK HOUSE - FRESH/SALT WATER, 115 AND 208 VOLT OUTLETS, FREEZER

Electric Power:

K.W. 30/40 Volts 115/208 [✓ AC]/DC

Winches:	TRAWL (DBLE DRUM)	BT (2)	OCEAN
Wire Size	1/2"	1/4"	3/32"
Length	4,000'	3,300'	27,000'
H. P.			

Booms/Cranes:

Type Hydraulic Cap 5,000 Lbs.

"A"-Frame YES

Echo Sounder Bendix DR-90 (600'), SIMRAD (400F) Precision Recorder

Nav. Equipment LORAN A, C, 24/32 MILE RADAR, COMPASS TO AUTOPILOT

Describe any special vessel capabilities CAN MOUNT 8' X 15' WET CHEMISTRY LAB ON AFT DECK

Vessel available for outside use? YES What Basis?

Cost: Per day Per week Other

Areal limits of operation

Other comments

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) ATLANTIS II (1963) Home Port WOODS HOLE, MA

Operating Institution:
WOODS HOLE OCEANOGRAPHIC INSTITUTE
WOODS HOLE, MA

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 210' Beam 44' Draft 16'

Displ. Tons 2,300 Cruising Speed 12

Machinery STEAM H.P. 1,400

Type Hull/Material STEEL

Accommodations:

	Crew	Scientists
Day Cruise		
Overnight	31	25
Ext. Cruise	31	25

Endurance:

Days Miles 8,000

Usual Areas of Operation:

Lab Spaces (Describe) 4 LABS, SHIPBOARD COMPUTER, UNDERWATER OBSERVATION PORTS

Electric Power:

K.W. Volts [✓ AC]/DC

Winches: 6 WINCHES

Wire Size

Length

H. P.

Booms/Cranes:

Type Cap

"A"-Frame

Echo Sounder YES Precision Recorder

Nav. Equipment LORAN, ADF, OMEGA, SATELLITE

Describe any special vessel capabilities

Vessel available for outside use? What Basis?

Cost: Per day Per week Other

Areal limits of operation

Other comments

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) DELAWARE II (1968) Home Port GLOUCESTER, MA

Operating Institution:
NOAA/NMFS
GLOUCESTER, MA

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 155' Beam 30' Draft 11'
Displ. Tons 680 Cruising Speed ____
Machinery DIESEL H.P. 1,000
Type Hull/Material STEEL
Accommodations:

	Crew	Scientists
Day Cruise		
Overnight	15	8
Ext. Cruise	15	8

Endurance:
Days ____ Miles 8,000
Usual Areas of Operation: ____

Lab Spaces (Describe) 250 FT^2 WET LAB
Electric Power: ____
K.W. 300 Volts 450/3 phase, 115/1 phase [✓ AC]/DC
Winches: DRUM TRAWLS (2) HYDRO
Wire Size
Length
H. P.
Booms/Cranes:
Type ____ Cap ____
"A"-Frame ____

Echo Sounder THREE Precision Recorder ____
Nav. Equipment LORAN A (3), GYRO, MAG COMPASS TO AUTOPILOT, 2 RADARS
Describe any special vessel capabilities ____
Vessel available for outside use? ____ What Basis? ____
Cost: Per day ____ Per week ____ Other ____
Areal limits of operation ____
Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY
Region I - Research Vessel Inventory

Vessel Name (yr. built) ENDEAVOR (1976) Home Port NARRAGANSETT, RI

Operating Institution:
UNIVERSITY of Rhode Island
GRADUATE SCHOOL OF OCEANOGRAPHY
KINGSTON, RI

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 177 Beam 33 Draft 17'6"
Displ. Tons ____ Cruising Speed 13.5
Machinery DIESEL H.P. 2,800
Type Hull/Material STEEL

Accommodations:

	Crew	Scientists
Day Cruise	___	___
Overnight	13	14
Ext. Cruise	13	14

Endurance:
Days 30 Miles 7000
Usual Areas of Operation: ____

Lab Spaces (Describe) YES

Electric Power: ____
K.W. 2(300) 1(200) Volts 440 [✓ AC]/DC
Winches: GENERAL STD HYDRO BT
Wire Size
Length
H. P.
Booms/Cranes:
Type ____ Cap ____
"A"-Frame ____

Echo Sounder YES - 2 Precision Recorder ____
Nav. Equipment LORAN A (2), C, SATELLITE, GYRO, MAG, RADAR, Doppler
Describe any special vessel capabilities ____
Vessel available for outside use? ____ What Basis? ____
Cost: Per day ____ Per week ____ Other ____
Areal limits of operation ____
Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) EVERGREEN (1943) Home Port GROTON, CONN

Operating Institution:
U.S. COAST GUARD
R&D CENTER
AVERY POINT
GROTON, CONN

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 180' Beam 37' Draft 13'

Displ. Tons 1,025 Cruising Speed 12

Machinery DIESEL H.P. 1,200

Type Hull/Material STEEL

Accommodations:

	Crew	Scientists
Day Cruise		
Overnight	45	7
Ext. Cruise	45	7

Endurance:

Days 45 Miles 19,000

Usual Areas of Operation:

Lab Spaces (Describe) ONE OCEANOGRAPHIC LAB

Electric Power:

K.W. Volts 120/240 [✓ AC] DC

Winches: OCEAN (2) BT SURF, TOW

Wire Size 5/32" 5/8"

Length 20,000 600'

H. P.

Booms/Cranes:

Type BUOY HANDLING Cap 20 TONS

"A"-Frame

Echo Sounder AN-C EDO (6,000 Fm) Precision Recorder

Nav. Equipment LORAN A, C, RADAR, GYRO, RDF, PATENT LOG

Describe any special vessel capabilities

Vessel available for outside use? What Basis?

Cost: Per day Per week Other

Areal limits of operation

Other comments

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) GULF MARINER (1955) Home Port New London, CT

Operating Institution:
TUG LEASING CORP.
SPARYARD STREET
P.O. BOX 968
NEW LONDON, CT. 06320

Name & Address of Contact:

(203) 442-0293
Tel. No. (Bus./After hrs.)

LOA 132' Beam 32' Draft 12'

Displ. Tons ____ Cruising Speed 10 KNTS

Machinery DIESEL H.P. 1,000

Type Hull/Material Supply vessel /STEEL

Accommodations:

	Crew	Scientists
Day Cruise	3	–
Overnight	5	10
Ext. Cruise	5	10

Endurance:

Days 30 Miles 3,000

Usual Areas of Operation: UNLIMITED

Lab Spaces (Describe) NONE

Electric Power: 60 CYCLE GENERATORS

K.W. 30 Volts 110/220 3 phase [✓ AC]/DC

Winches: AS REQUIRED

Wire Size

Length

H. P.

Booms/Cranes:

Type ARTICULATED HYDRAULIC Cap 5 TONS

"A"-Frame ____

Echo Sounder ____ Precision Recorder ____

Nav. Equipment ____

Describe any special vessel capabilities Complete Diving capability including SCUBA and surface supply AIR

Vessel available for outside use? YES What Basis? ____

Cost: Per day ____ Per week ____ Other ____

Areal limits of operation NONE

Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) KNORR (1970) Home Port WOODS HOLE, MA

Operating Institution:
WOODS HOLE OCEANOGRAPHIC INSTITUTE
WOODS HOLE, MA

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 245' Beam 46' Draft 16'

Displ. Tons ______ Cruising Speed 10

Machinery DIESEL H.P. 2,500

Type Hull/Material STEEL

Accommodations:

	Crew	Scientists
Day Cruise	___	___
Overnight	25	25
Ext. Cruise	25	25

Endurance:

Days ______ Miles 10,000

Usual Areas of Operation: ______

Lab Spaces (Describe) YES

Electric Power: ______

K.W. ______ Volts ______ AC/DC

Winches: HYDRO (2) TRAWL (1)

Wire Size

Length

H. P.

Booms/Cranes:

Type ______ Cap ______

"A"-Frame ______

Echo Sounder YES Precision Recorder YES

Nav. Equipment LORAN (2), GYRO, SATELLITE, OMEGA

Describe any special vessel capabilities ______

Vessel available for outside use? ______ What Basis? ______

Cost: Per day ______ Per week ______ Other ______

Areal limits of operation ______

Other comments ______

U. S. ENVIRONMENTAL PROTECTION AGENCY
Region I - Research Vessel Inventory

Vessel Name (yr. built) OCEANUS (1975) Home Port WOODS HOLE, MA

Operating Institution:
WOODS HOLE OCEANOGRAPHIC INSTITUTE
WOODS HOLE, MA

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 177′ Beam 30′ Draft 16′ 6″
Displ. Tons ______ Cruising Speed ______
Machinery DIESEL H.P. ______
Type Hull/Material STEEL
Accommodations:

	Crew	Scientists
Day Cruise		
Overnight	12	12
Ext. Cruise	12	12

Endurance:
Days ______ Miles 10,000
Usual Areas of Operation: ______

Lab Spaces (Describe) YES

Electric Power: ______
K.W. 600 Volts 440 [✓ AC]/DC
Winches: TRAWL HYDRO
Wire Size
Length
H. P.
Booms/Cranes:
Type ______ Cap ______
"A"-Frame ______

Echo Sounder YES Precision Recorder YES
Nav. Equipment LORAN A, C, GYRO, RADAR, SATELLITE
Describe any special vessel capabilities ______

Vessel available for outside use? ______ What Basis? ______
Cost: Per day ______ Per week ______ Other ______
Areal limits of operation ______
Other comments ______

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) VAST EXPLORER III (1968) Home Port So. Bristol, Maine

Operating Institution:
VAST Inc.
Air/Maritime Services Division
Box 384
Newcastle, Maine 04553

Name & Address of Contact:
Charles L. Wyman, Director

(207) 563-3193
Tel. No. (Bus./After hrs.)

LOA 85' Beam 24' Draft 9'

Displ. Tons ____ Cruising Speed ____

Machinery DIESEL (2) H.P. 440

Type Hull/Material Chine-hull / Steel

Accommodations:

	Crew	Scientists
Day Cruise	4	14
Overnight	5	11-13
Ext. Cruise	6	10-12

Endurance:

Days 12 Miles 3,000

Usual Areas of Operation:
Caribbean/Atlantic/Gulf of Maine

Lab Spaces (Describe) 220 FT^2 Air-Conditioned electronics Lab; wet Lab added as required

Electric Power: 3 generators

K.W. 20/40/55 Volts 115/220 [✓ AC]/DC

Winches: 400 Lb.

Wire Size 3/32"

Length 3,000'

H. P. 5

Booms/Cranes:

Type ____ Cap ____

"A"-Frame Add-on

Echo Sounder Simrad - 600 Fathom Precision Recorder Simrad

Nav. Equipment Loran, Radar

Describe any special vessel capabilities ____

Vessel available for outside use? YES What Basis? ____

Cost: Per day ____ Per week ____ Other ____

Areal limits of operation ____

Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) R/V WESTWARD (1961) Home Port BOSTON, MASS.

Operating Institution:
Sea Education Association
3 School Street
Boston, MA 02108

Name & Address of Contact:
Corwith Cramer, JR
(617) 742-4246
Tel. No. (Bus./After hrs.)

LOA 100' Beam 22' Draft 12' 6"

Displ. Tons 220 Cruising Speed 8 KTS

Machinery DIESEL H.P. 350

Type Hull/Material YACHT / STEEL

Accommodations:

	Crew	Scientists
Day Cruise	7	2-4
Overnight	7	2-4
Ext. Cruise	7	2-4

Endurance:

Days 50 Miles 5,000

Usual Areas of Operation: EASTERN U.S. & CANADA, Europe, Caribbean

Lab Spaces (Describe) 100 FT^2 Lab, additional 150 FT^2 on deck

Electric Power:

K.W. 10 Volts 120 AC/[✓ DC]

Winches:	HydRO	BT
Wire Size	3/16"	STD.
Length	20,000'	6,000'
H. P.	5	½

Booms/Cranes:

Type Non-Telescoping Cap 1,000 LBS

"A"-Frame

Echo Sounder ATLAS Echograph, Monograph Precision Recorder

Nav. Equipment LORAN, Decca Radar, Raytheon RDF

Describe any special vessel capabilities Capable of silent operation under sail; photo Lab

Vessel available for outside use? yes What Basis?

Cost: Per day Per week Other

Areal limits of operation

Other comments Crew requirements supplemented by 15-20 students

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built)__________________________ Home Port ____________________

Operating Institution:

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA __________ Beam______Draft________

Displ. Tons________Cruising Speed______

Machinery________________H.P.________

Type Hull/Material____________________

Accommodations:

	Crew	Scientists
Day Cruise	____	____
Overnight	____	____
Ext. Cruise	____	____

Endurance:

Days________ Miles________

Usual Areas of Operation: ____________

____

Lab Spaces (Describe)________________

____

____

Electric Power: ____________________

K.W.________Volts____________ AC/DC

Winches: ___________________________

Wire Size

Length

H. P.

Booms/Cranes:

Type____________Cap______________

"A"-Frame_________________________

Echo Sounder ______________________________Precision Recorder________________

Nav. Equipment ____

Describe any special vessel capabilities ____________________________________

____

Vessel available for outside use? ________ What Basis? ____________________

Cost: Per day ________________ Per week ________________ Other ______________

Areal limits of operation ____

Other comments ____

____

NEARSHORE VESSELS - SHORT ENDURANCE

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) DULCINEA (1944) Home Port JERUSALEM, RI

Operating Institution:
University of Rhode Island
Graduate School of Oceanography
Kingston, RI 02881

Name & Address of Contact:
C. A. Buehrens, Marine Superintendent
Tel. No. (Bus./After hrs.) (401) 792-6203

LOA 40' Beam 12' Draft 4'

Displ. Tons ____ Cruising Speed 10 KTS

Machinery DIESEL H.P. 165

Type Hull/Material NAVY UTILITY / WOOD

Accommodations:

	Crew	Scientists
Day Cruise	1	5
Overnight	–	–
Ext. Cruise	–	–

Endurance:

Days ____ Miles ____

Usual Areas of Operation: ____

Lab Spaces (Describe) NONE

Electric Power: ____

K.W. ____ Volts ____ AC/DC

Winches: ____

Wire Size COMMON TYPE

Length FISHING TRAWL WINCH

H. P.

Booms/Cranes:

Type MAST & BOOM Cap ____

"A"-Frame ____

Echo Sounder ____ Precision Recorder ____

Nav. Equipment ____

Describe any special vessel capabilities Rigged for EXPERIMENTAL Fishing

Vessel available for outside use? YES What Basis? ____

Cost: Per day ____ Per week ____ Other ____

Areal limits of operation ____

Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY
Region I - Research Vessel Inventory

Vessel Name (yr. built) F.C. WILBOUR (1964) Home Port BOSTON, MA (berthed in Sandwich)

Operating Institution:
MASS. DIVISION OF MARINE FISHERIES
100 CAMBRIDGE STREET
BOSTON, MA 02202

Name & Address of Contact:
Philip Coates
(617) 727-3193
Tel. No. (Bus./After hrs.)

LOA 50' Beam 16' Draft 4'6"
Displ. Tons ______ Cruising Speed 10 KTS
Machinery DIESEL H.P. 150
Type Hull/Material F/V / WOOD
Accommodations:

	Crew	Scientists
Day Cruise	2	4
Overnight	2	
Ext. Cruise	–	–

Endurance:
Days ______ Miles 370
Usual Areas of Operation:
Coastal waters of Massachusetts

Lab Spaces (Describe) NONE
Electric Power:
K.W. 50 Amp ALT. Volts 12 AC/DC
Winches: HANCOCK Double Drum
Wire Size 7/16" Hydraulic 21" Drums
Length 600 6X19 wire
H. P. 24
Booms/Cranes:
Type 4" Pipe Cap 1 TON
"A"-Frame ______

Echo Sounder Raytheon Flasher Precision Recorder FURUNO F.M. 22
Nav. Equipment MAG. compass
Describe any special vessel capabilities ______

Vessel available for outside use? ______ What Basis? ______
Cost: Per day ______ Per week ______ Other ______
Areal limits of operation COASTAL waters
Other comments ______

U. S. ENVIRONMENTAL PROTECTION AGENCY
Region I - Research Vessel Inventory

Vessel Name (yr. built) LEE (1975) Home Port

Operating Institution:
IRA C. DARLING CENTER
UNIVERSITY OF MAINE
WALPOLE, ME 04573

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 34' Beam 10'6" Draft 3'6"
Displ. Tons 10 Cruising Speed
Machinery DIESEL H.P. 210
Type Hull/Material
Accommodations:

	Crew	Scientists
Day Cruise	1	
Overnight		
Ext. Cruise		

Endurance:
Days Miles
Usual Areas of Operation:

Lab Spaces (Describe) NONE
Electric Power:
K.W. Volts AC/DC
Winches:
Wire Size
Length 5,000'
H. P.
Booms/Cranes:
Type Cap
"A"-Frame

Echo Sounder Precision Recorder
Nav. Equipment RADAR, MAG. COMPASS
Describe any special vessel capabilities
Vessel available for outside use? What Basis?
Cost: Per day Per week Other
Areal limits of operation
Other comments

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) MICMAC Home Port PORT JEFFERSON, N.Y.

Operating Institution:
MARINE SCIENCES RESEARCH CENTER
STATE UNIVERSITY OF NEW YORK
STONY BROOK, NEW YORK 11790

Name & Address of Contact:
FREDERICK G. ROBERTS, ASSOC. DIRECTOR
MARINE SCIENCES RESEARCH CENTER
Tel. No. (Bus./After hrs.)

LOA 39' 11" Beam ____ Draft 4'

Displ. Tons ____ Cruising Speed 10 KTS

Machinery DIESEL H.P. 165

Type Hull/Material NOVA SCOTIA / WOOD

Accommodations:

	Crew	Scientists
Day Cruise	____	10
Overnight	-	-
Ext. Cruise	-	-

Endurance:

Days 15 HRS Miles 150

Usual Areas of Operation: L.I. SOUND, NY HARBOR, GREAT BAY SOUTH

Lab Spaces (Describe) Equivalent 20 FT^2; bench space in cabin; 75 FT^2 deck space

Electric Power: ONAN GENERATOR

K.W. 3 Volts 110 [✓ AC]/DC

Winches: Single drum Hand

Wire Size 3/16"

Length 400'

H. P.

Booms/Cranes:

Type GIN POLLS Cap 600 LBS

"A"-Frame ____

Echo Sounder RAYTHEON 77 Precision Recorder ELAC

Nav. Equipment RADAR, AUTO PILOT

Describe any special vessel capabilities ____

Vessel available for outside use? YES What Basis? ____

Cost: Per day ____ Per week ____ Other ____

Areal limits of operation ____

Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) MISS BESS (1967) Home Port ____

Operating Institution:
IRA C. DARLING CENTER
UNIVERSITY OF MAINE
WALPOLE, ME 04573

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA 34' Beam 10'6" Draft 4'

Displ. Tons 12 Cruising Speed 9

Machinery DIESEL H.P. 118

Type Hull/Material ____

Accommodations:

	Crew	Scientists
Day Cruise	1	3
Overnight		
Ext. Cruise		

Endurance:

Days ____ Miles 400

Usual Areas of Operation: ____

Lab Spaces (Describe) NONE

Electric Power: ____

K.W. ____ Volts ____ AC/DC

Winches: POT HAULER

Wire Size

Length

H. P.

Booms/Cranes:

Type ____ Cap ____

"A"-Frame ____

Echo Sounder ____ Precision Recorder ____

Nav. Equipment ____

Describe any special vessel capabilities ____

Vessel available for outside use? ____ What Basis? ____

Cost: Per day ____ Per week ____ Other ____

Areal limits of operation ____

Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) SARSIA (1949) Home Port NAHANT, MA

Operating Institution:
Northeastern University
Marine Science Institute
East Point
Nahant, Mass. 01908

Name & Address of Contact:
Dr. Nathan W. Riser, Director

Tel. No. (Bus./After hrs.) (617) 581-1170

LOA 40' Beam ____ Draft 4'

Displ. Tons ____ Cruising Speed ____

Machinery GRAY MARINE H.P. 150

Type Hull/Material NOVA SCOTIA/WOOD

Accommodations:

	Crew	Scientists
Day Cruise	-	8
Overnight	-	-
Ext. Cruise	-	-

Endurance:

Days day only Miles ____

Usual Areas of Operation: MASS. BAY

Lab Spaces (Describe) ____

Electric Power: ____

K.W. ____ Volts ____ AC/DC

Winches: Hand

Wire Size 3/8"

Length 500'

H. P.

Booms/Cranes:

Type davit Cap ____

"A"-Frame ____

Echo Sounder ____ Precision Recorder ____

Nav. Equipment ____

Describe any special vessel capabilities ____

Vessel available for outside use? YES What Basis? ____

Cost: Per day ____ Per week ____ Other ____

Areal limits of operation ____

Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) SCHROCK (1965) Home Port BOSTON, MA

Operating Institution:
MASSACHUSETTS INSTITUTE OF
TECHNOLOGY
CAMBRIDGE, MASS. 02138

Name & Address of Contact:
PROFESOR ERIK MOLLO-CHRISTENSEN
(67) 253-7910
Tel. No. (Bus./After hrs.)

LOA 50' Beam ______ Draft 3'

Displ. Tons ________ Cruising Speed 10 KTS

Machinery DIESEL H.P. 280

Type Hull/Material NAVY LAUNCH / WOOD

Accommodations:

	Crew	Scientists
Day Cruise	___	6
Overnight	___	–
Ext. Cruise	___	–

Endurance:

Days ________ Miles ________

Usual Areas of Operation:
MASSACHUSETTS BAY, BUZZARDS BAY

Lab Spaces (Describe) 10' X 12', SINK
3 ELECTRONICS RACKS

Electric Power: ________

K.W. 12 Volts 110 [✓ AC] DC

Winches: HOISTING

Wire Size 1/4"

Length 400'

H. P.

Booms/Cranes:

Type ________ Cap 2,000 LBS

"A"-Frame YES

Echo Sounder RAYTHEON Precision Recorder ________

Nav. Equipment LORAN, RADAR

Describe any special vessel capabilities ________

Vessel available for outside use? YES What Basis? ________

Cost: Per day ________ Per week ________ Other ________

Areal limits of operation ________

Other comments ________

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) WRACK (1969) Home Port Appledore Island, ME.

Operating Institution:
SHOALS MARINE LABORATORY
WINTER
202 PLANT SCIENCE Bldg
CORNELL UNIVERSITY
ITHACA, NY 14850

SUMMER
PO BOX 178
PORTSMOUTH, N.H.
03801

Name & Address of Contact:
J. M. KINGSBURY, DIRECTOR

Tel. No. (Bus./After hrs.)

LOA 33'8" Beam 11'6" Draft 3'

Displ. Tons ________ Cruising Speed 10 KTS

Machinery DIESEL H.P. 133

Type Hull/Material F/U / WOOD

Accommodations:

	Crew	Scientists
Day Cruise	1	3-4
Overnight	1	1
Ext. Cruise	-	-

Endurance:

Days 1 Miles 120

Usual Areas of Operation: WITHIN 20 MILES of the Isles of Shoals

Lab Spaces (Describe) NONE

Electric Power:

K.W. ________ Volts 12/24 AC/DC

Winches:	1	2
Wire Size	3/8"	3/8"
Length	1000'	1000'
H. P.		

Booms/Cranes:

Type SPAR BOOM Cap 1000 LBS

"A"-Frame NO

Echo Sounder BENMAR Precision Recorder ________

Nav. Equipment RADAR

Describe any special vessel capabilities ________

Vessel available for outside use? YES What Basis? ________

Cost: Per day ________ Per week ________ Other ________

Areal limits of operation WITHIN 40 MILES of The Isles of SHOALS

Other comments ________

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built)__________________ Home Port ______________

Operating Institution:

Name & Address of Contact:

Tel. No. (Bus./After hrs.)

LOA ________ Beam _____ Draft ______

Displ. Tons ______ Cruising Speed _____

Machinery ____________ H.P. ______

Type Hull/Material ______________

Accommodations:

	Crew	Scientists
Day Cruise	___	___
Overnight	___	___
Ext. Cruise	___	___

Endurance:

Days ______ Miles ______

Usual Areas of Operation: __________

____

Lab Spaces (Describe) ______________

____

____

Electric Power: ______________

K.W. ______ Volts ________ AC/DC

Winches: __________________

Wire Size

Length

H. P.

Booms/Cranes:

Type ________ Cap ________

"A"-Frame ______________

Echo Sounder ____________________ Precision Recorder ____________

Nav. Equipment ______________________________________

Describe any special vessel capabilities ____________________________

____

Vessel available for outside use? ______ What Basis? ______________

Cost: Per day __________ Per week __________ Other __________

Areal limits of operation ______________________________

Other comments ____

____

NEARSHORE VESSELS - LONG ENDURANCE

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) A.E. VERRILL (1966) Home Port WOODS HOLE, MA

Operating Institution:

MARINE BIOLOGICAL LABORATORY
Woods Hole, Mass. 02543

Name & Address of Contact:

John J. Valois, Mgr.
Supply Dept
(617) 548-3705 x 325
Tel. No. (Bus./After hrs.)

LOA 65' Beam 18' Draft 6'6"

Displ. Tons ______ Cruising Speed 9.5 KTS

Machinery DIESEL H.P. 235

Type Hull/Material R/V / STEEL

Accommodations:

	Crew	Scientists
Day Cruise	2	10
Overnight	2	5
Ext. Cruise	2	5

Endurance:

Days 7 Miles 1,000

Usual Areas of Operation: MAINE TO N.Y.

Lab Spaces (Describe) 170 FT^2, NON-TOXIC SEA WATER, HOT & COLD FRESH WATER, SORTING TABLE, benches

Electric Power: ______

K.W. 15 Volts 110/220 [✓ AC] DC

Winches:	DBL. TRAWL	BT
Wire Size	3/8"	1/8"
Length	750 M	300 m
H. P.		

Booms/Cranes:

Type 20' BOOM Cap 2000 LBS

"A"-Frame HYDRAULIC - 4,000 LBS

Echo Sounder Recording Precision Recorder ______

Nav. Equipment LORAN A, C - DUAL TRACKING, RADAR, AUTO PILOT

Describe any special vessel capabilities C P Propeller, Quartz Flood Lights, 80 FT^2 WORK SHOP, 16 FT^3 FREEZER, ALL COMPARTMENTS HEATED

Vessel available for outside use? YES What Basis? ______

Cost: Per day ______ Per week ______ Other ______

Areal limits of operation CONTINENTAL SHELF

Other comments ______

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) AQUALAB III (1957) Home Port S. PorTland

Operating Institution:
DEPT. OF MARINE SCIENCE & TECHNOLOGY
SOUTHERN MAINE VOCATIONAL TECHNICAL INST.
FORT ROAD
SOUTH PORTLAND, MAINE 04106

Name & Address of Contact:
Tapan Banerjee
CHAIRMAN, Dept of Marine Science & Technology
(207) 799-7303 x 67
Tel. No. (Bus./After hrs.)

LOA 144 Beam ______ Draft 8'6"
Displ. Tons 350 Cruising Speed 12 KTS
Machinery DIESEL H.P. 600
Type Hull/Material MINE SWEEPER/WOOD
Accommodations:

	Crew	Scientists
Day Cruise	4	76
Overnight	7	42
Ext. Cruise	7	42

Endurance:
Days 4 1/2 Miles 1,100
Usual Areas of Operation:
CASCO BAY / GULF OF MAINE

Lab Spaces (Describe) ______
Electric Power: ______
K.W. ______ Volts 440 [✓ AC]/DC
Winches: STERN
Wire Size 1/4"
Length 2 wires of 50 fathoms each on separate drums
H. P.
Booms/Cranes:
Type NONE Cap ______
"A"-Frame ______

Echo Sounder YES Precision Recorder ______
Nav. Equipment LORAN, RADAR, GYRO, MAG. COMPASS, VHF, MF
Describe any special vessel capabilities Hydro winch, BT winch, dry lab
Vessel available for outside use? YES What Basis? ______
Cost: Per day ______ Per week ______ Other ______
Areal limits of operation COASTWIDE OPERATIONS - NOT MORE THAN 20 miles offshore
Other comments ______

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) ASTERIAS (1931) Home Port WOODS HOLE, MASS

Operating Institution:
Woods Hole Oceanographic Institute
Woods Hole, Mass. 02543

Name & Address of Contact:
MR. R.S. Edwards
Marine SuperinTendent
(617) 548-1400 X 247
Tel. No. (Bus./After hrs.)

LOA 41' Beam 13' Draft 4'

Displ. Tons 15 Cruising Speed 8 KTS

Machinery DIESEL H.P. 68

Type Hull/Material DRAGGER / WOOD

Accommodations:

	Crew	Scientists
Day Cruise	1	12
Overnight	1	3
Ext. Cruise	2	2

Endurance:

Days 3 Miles 525

Usual Areas of Operation:

LOCAL CAPE COD

Lab Spaces (Describe)

ONE DECK LAB 8' X 10'

Electric Power:

K.W. 7.5 Volts 110 [✓ AC]/DC

Winches:	#1	#2
Wire Size	3/8"	3/16"
Length	200'	600'
H. P.		

Booms/Cranes: NONE

Type Cap

"A"-Frame NO

Echo Sounder RayTheon FAThometer Junior Precision Recorder optional

Nav. Equipment LORAN A, 101 RADAR

Describe any special vessel capabilities

Vessel available for outside use? YES What Basis?

Cost: Per day Per week Other

Areal limits of operation

Other comments

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) BIGELOW (1950) Home Port WEST BOOTH BAY HARBOR, M

Operating Institution:
BIGELOW LABORATORY FOR OCEAN SCIENCE
McKNOWN POINT
WEST BOOTH BAY HARBOR, ME
04575

Name & Address of Contact:
MR. JACK LAIRD

Tel. No. (Bus./After hrs.)

LOA 47' Beam ____ Draft 4'

Displ. Tons ____ Cruising Speed ____

Machinery DIESEL H.P. 270

Type Hull/Material FISHING / WOOD

Accommodations:

	Crew	Scientists
Day Cruise		20
Overnight	2	2
Ext. Cruise	-	-

Endurance:

Days 3 Miles 500

Usual Areas of Operation:
GULF OF MAINE

Lab Spaces (Describe)
8'X12' WORKING LAB
16'X20' deck space

Electric Power:

K.W. 7.5 Volts 110/220 [✓ AC]/DC

Winches:

Wire Size 7/16"

Length 500 m

H. P.

Booms/Cranes:

Type ____ Cap ____

"A"-Frame YES

Echo Sounder YES (2) Precision Recorder YES

Nav. Equipment LORAN

Describe any special vessel capabilities

Vessel available for outside use? YES What Basis? IF AVAILABLE, COST REIMBURS.

Cost: Per day ____ Per week ____ Other ____

Areal limits of operation GULF OF MAINE

Other comments

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) CORSAIR Home Port FAIRHAVEN, MA.

Operating Institution:
SouTheasTERN Massachusetts Univ.
NORTh DARTmouTh, Mass. 02747

Name & Address of Contact:
MR. Gilbert FAIN
Assoc. Prof., F Electrical Engineering
Tel. No. (Bus./After hrs.) (617) 997-9321 x 357

LOA 65' Beam ____ Draft 5'

Displ. Tons ____ Cruising Speed 11 KTS

Machinery DIESEL (2) H.P. 180

Type Hull/Material MOTOR / WOOD

Accommodations:

	Crew	Scientists
Day Cruise	2	12
Overnight	2	2
Ext. Cruise	2	2

Endurance:

Days 3 Miles 360

Usual Areas of Operation: BUZZARDS BAY

Lab Spaces (Describe)
1 WET LAB
1 DRY LAB

Electric Power:

K.W. 25 Volts 120/220 3ph [✓ AC]/DC

Winches: HAND DBLE DRM HYDRAULIC

Wire Size

Length

H. P.

Booms/Cranes:

Type ____ Cap 3000 Lbs

"A"-Frame STERN - 3 TON

Echo Sounder ____ Precision Recorder YES

Nav. Equipment LORAN, RADAR

Describe any special vessel capabilities ____

Vessel available for outside use? YES What Basis? ____

Cost: Per day ____ Per week ____ Other ____

Areal limits of operation ____

Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY
Region I - Research Vessel Inventory

Vessel Name (yr. built) R/V CROWS NEST VI (1962) Home Port JAMESTOWN, R.I.

Operating Institution:
University of Rhode Island
OCEAN ENGINEERING DEPT.
KINGSTON, RI 02881

Name & Address of Contact:
C. A. Buehrens, Marine Superintendent
(401) 792-6203
Tel. No. (Bus./After hrs.)

LOA 45' Beam 13' Draft 3'6"
Displ. Tons ____ Cruising Speed 12 KTS
Machinery DIESEL (2) H.P. 175
Type Hull/Material CRUISER / WOOD
Accommodations:

	Crew	Scientists
Day Cruise	1	7
Overnight	3	3
Ext. Cruise	-	-

Endurance:
Days 4 Miles 506
Usual Areas of Operation:
NARRAGANSETT BAY

Lab Spaces (Describe) AFTER CABIN LAB
Electric Power:
K.W. 2.5 Volts 110 [✓ AC] DC
Winches:
Wire Size
NONE
Length
H. P.
Booms/Cranes:
Type ____ Cap ____
"A"-Frame ____

Echo Sounder SIDE SCAN SONAR Precision Recorder ____
Nav. Equipment ____
Describe any special vessel capabilities ____
Vessel available for outside use? YES What Basis? ____
Cost: Per day ____ Per week ____ Other ____
Areal limits of operation NARRAGANSETT BAY
Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) F/V GAIL ANN (1965) Home Port WICKFORD, RI

Operating Institution:
UNIVERSITY of Rhode Island
School of Fisheries & Marine Technology
Kingston, RI 02881

Name & Address of Contact:
C.A. Buchrens, Marine Superintendent
(401) 792-6203
Tel. No. (Bus./After hrs.)

LOA 47' Beam 13' Draft 6'

Displ. Tons ____ Cruising Speed 9 KTS

Machinery DIESEL H.P. 140

Type Hull/Material F/V / WOOD

Accommodations:

	Crew	Scientists
Day Cruise	1	11
Overnight	1	2
Ext. Cruise	–	–

Endurance:

Days 3 Miles 350

Usual Areas of Operation: NARRAGANSETT BAY & RI SOUND

Lab Spaces (Describe) OPEN DECK

Electric Power:

K.W. 6/5 Volts 110 [✓ AC]/DC

Winches: TRAWL

Wire Size 3/16"

Length 800'

H. P.

Booms/Cranes:

Type TRAWL BOOM Cap 1 TON

"A"-Frame NO

Echo Sounder Side Scanning Precision Recorder

Nav. Equipment

Describe any special vessel capabilities

Vessel available for outside use? YES What Basis?

Cost: Per day ____ Per week ____ Other

Areal limits of operation NARRAGANSETT BAY & RI SOUND

Other comments

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) R/V JERE A. CHASE (1964) Home Port Durham, New Hampshire

Operating Institution:
JACKSON ESTUARINE LABORATORY
RFD #1 ADAMS POINT
DURHAM, New Hampshire 03824

Name & Address of Contact:
DR ARTHUR C. MATHIESON, DIRECTOR

Tel. No. (Bus./After hrs.) (603) 862-2175

LOA 45' Beam 13' Draft 4'
Displ. Tons 22 Cruising Speed 10 KTS
Machinery DIESEL H.P. 130
Type Hull/Material TRAWLER / WOOD

Accommodations:

	Crew	Scientists
Day Cruise	1	10
Overnight	2	4
Ext. Cruise	2	4

Endurance:
Days 14 Miles 1000
Usual Areas of Operation: COASTAL WATERS

Lab Spaces (Describe) 6'X9' WITH COUNTERS, SHELVES drying RACKS
Electric Power:
K.W. 3 Volts 12DC, 24DC, 120 [✓ AC]/DC

Winches:	#1	#2
Wire Size	1/8"	1/4"
Length	1000'	1000'
H. P.	5	5

Booms/Cranes:
Type 1 BOOM Cap 800 LbS
"A"-Frame YES - 1000 Lbs cap.

Echo Sounder #1 - 200' #2 - 800' Precision Recorder DECCA RANGE MARKER
Nav. Equipment LORAN A, VHF-FM TRANSCEIVER
Describe any special vessel capabilities ZODIAC AND DIVING PLATFORM FOR SCUBA DIVING
Vessel available for outside use? YES What Basis?
Cost: Per day Per week Other
Areal limits of operation GULF OF MAINE
Other comments

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) KYMA (1952) Home Port MONTAUK, N.Y.

Operating Institution:
NEW YORK OCEAN SCIENCE LABORATORY
operated by AFFILIATED Colleges &
UNIVERSITIES INC.
Drawer EE
MONTAUK, New YORK 11954

Name & Address of Contact:
DR. RUDOLPH HOLLMAN
Research SCIENTIST
(516)-668-5800
Tel. No. (Bus./After hrs.)

LOA 65' Beam 20' Draft 7.5'

Displ. Tons ______ Cruising Speed 9 KTS

Machinery DIESEL H.P. 275

Type Hull/Material TUG / STEEL

Accommodations:

	Crew	Scientists
Day Cruise	2	14
Overnight	3	6
Ext. Cruise	4	5

Endurance:

Days 6 Miles 1200

Usual Areas of Operation: LONG ISLAND & BLOCK ISLAND SOUNDS, N.Y. BIGHT

Lab Spaces (Describe) Converted cargo hold - 300 sq. FT. with Lab benches, sinks, etc.

Electric Power: ______

K.W. 20 Volts 110 [✓ AC/DC]

Winches: Hydraulic BT

Wire Size 3/8"

Length 20,000'

H. P.

Booms/Cranes:

Type Cargo Davit Cap 2,500 Lbs.

"A"-Frame 10'

Echo Sounder Raytheon, Model DE714/715 Precision Recorder ______

Nav. Equipment LORAN A & C, DECCA RADAR

Describe any special vessel capabilities ______

Vessel available for outside use? YES What Basis? ______

Cost: Per day ______ Per week ______ Other ______

Areal limits of operation ______

Other comments ______

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) SHAWNA IV (1948) Home Port Southampton

Operating Institution:
MARINE SCIENCE CENTER
Southampton College
Southampton, L.I., New York

Name & Address of Contact:
J.R. Welker, Director
Marine Operations and Research
Tel. No. (Bus./After hrs.) (516) 283-4000 x 228

LOA .38' Beam 12'8" Draft 4'

Displ. Tons 12 Cruising Speed 10 KTS

Machinery DIESEL (2) H.P. 280

Type Hull/Material TRAWLER / WOOD

Accommodations:

	Crew	Scientists
Day Cruise	2	4-6
Overnight	2	2-3
Ext. Cruise	2	2-3

Endurance:

Days 7 Miles 400

Usual Areas of Operation: ATLANTIC SHELF OF E.L.I., BLOCK ISLAND SOUND

Lab Spaces (Describe) SMALL WET LAB

Electric Power: 5 KW GENERATOR AVAILABLE

K.W. ______ Volts ______ AC/DC

Winches: ______

Wire Size 5/32"

Length 500'

H. P. 2

Booms/Cranes:

Type 12' Cap 1000 LBS

"A"-Frame ______

Echo Sounder Raytheon 260' Precision Recorder YES

Nav. Equipment RADAR

Describe any special vessel capabilities ______

Vessel available for outside use? YES What Basis? ______

Cost: Per day ______ Per week ______ Other ______

Areal limits of operation COASTAL WATERS

Other comments ______

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) R/V Subsig II (1968) Home Port Newport, R.I.

Operating Institution:
Raytheon Company
Box 360
Portsmouth, R. I. 02871

Name & Address of Contact:
Capt Robert Brown, Mgr.
Marine Test Facilities
401-847-8000
Tel. No. (Bus./After hrs.)

LOA 118' Beam 28' Draft 13' 6"

Displ. Tons 660 Cruising Speed 12.6 KTS

Machinery Diesel H.P. 970

Type Hull/Material Stern Trawler/Steel

Accommodations:

	Crew	Scientists
Day Cruise	8	12
Overnight	8	12
Ext. Cruise	8	12

Endurance:

Days 30 Miles 6000

Usual Areas of Operation: U.S. East Coast, Central America

Lab Spaces (Describe) Forward: 345 ft.², 42" Sea Chest; Aft: 600 ft², w/ Direct Access to Deck.

Electric Power: 55 KW Generators (2)

K.W. 55 Volts 110/220/440 [✓ AC] DC

Winches: 6 Ton Capstan 5 Ton Dowace Drum

Wire Size 1/4"

Length 3000'

H. P. Others on Board.

Booms/Cranes:

Type Telescoping Hydraulic Cap 5 Ton

"A"-Frame Hyraulic - 5 Ton

Echo Sounder 4 Fathometers (Recording) Precision Recorder Available

Nav. Equipment Loran A + C, 2 Radars, Gyro Compass, High Seas and VHF Radios.

Describe any special vessel capabilities Bow/Stern Thrusters, Auto. Pilot, Medium Ice Service Construction

Vessel available for outside use? Yes What Basis? Daily, Weekly, Monthly (As Available)

Cost: Per day $2650 - all expenses Per week Other

Areal limits of operation None

Other comments Min. Speed = 3 KTS, Modified Ice Breaker

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) T-441 (1953) Home Port NOANK, CT

Operating Institution:
MARINE SCIENCES INSTITUTE
UNIVERSITY OF CONNECTICUT
SE BRANCH, AVERY POINT
GROTON, CT 06340

Name & Address of Contact:
DR. PETER DEHLINGER

203-446-1020 x 211
Tel. No. (Bus./After hrs.)

LOA 65' Beam 16' Draft 8'

Displ. Tons ____ Cruising Speed 10 KTS

Machinery DIESEL H.P. 275

Type Hull/Material PASS. VESSEL / STEEL

Accommodations:

	Crew	Scientists
Day Cruise	3	18
Overnight	5	5
Ext. Cruise	5	5

Endurance:

Days 7 Miles 1680

Usual Areas of Operation: ____

Lab Spaces (Describe) ____
MAIN DECK 12' x 15'

Electric Power: ____

K.W. — Volts 120 [✓ AC]/DC

Winches: OCEAN. BT

Wire Size 1/4" 3/32"

Length 900' 500'

H. P.

Booms/Cranes:

Type 50' 1/4" CABLES Cap 4200 lbs

"A"-Frame NO

Echo Sounder YES Precision Recorder YES

Nav. Equipment RADAR

Describe any special vessel capabilities ____

Vessel available for outside use? YES What Basis? ____

Cost: Per day ____ Per week ____ Other ____

Areal limits of operation ____

Other comments ____

U. S. ENVIRONMENTAL PROTECTION AGENCY

Region I - Research Vessel Inventory

Vessel Name (yr. built) R/V UCONN (1943) Home Port NOANK, CT

Operating Institution:
MARINE SCIENCES INSTITUTE
UNIVERSITY OF CONNECTICUT
SE BRANCH, AVERY POINT
GROTON, CT 06340

Name & Address of Contact:
DR. PETER DEHLINGER

203-446-1020 X 211
Tel. No. (Bus./After hrs.)

LOA 65' Beam 16' Draft 7'4"
Displ. Tons ______ Cruising Speed 10 KTS
Machinery DIESEL H.P. 180
Type Hull/Material PASS. VESSEL / WOOD
Accommodations:

	Crew	Scientists
Day Cruise	3	18
Overnight	5	5
Ext. Cruise	5	5

Endurance:
Days 5 Miles 1200
Usual Areas of Operation: BLOCK ISLAND, LONG ISLAND & FISHERS ISLAND SOUND

Lab Spaces (Describe)
MAIN DECK [illegible]'x8'

Electric Power:
K.W. ______ Volts 120 [✓ AC]/DC

Winches:	DR. DRUM	Beebe	BT
Wire Size	3/8"	1/4"	1/8"
Length	600'	400'	600'
H. P.			

Booms/Cranes:
Type General Purpose Cap 2000 lbs
"A"-Frame ______

Echo Sounder YES Precision Recorder YES
Nav. Equipment Radar
Describe any special vessel capabilities ______

Vessel available for outside use? YES What Basis? ______
Cost: Per day ______ Per week ______ Other ______
Areal limits of operation BLOCK ISLAND, LONG ISLAND & FISHER'S ISLAND SOUND
Other comments ______

U. S. ENVIRONMENTAL PROTECTION AGENCY
Region I - Research Vessel Inventory

Vessel Name (yr. built) WHITEFOOT (1970) Home Port VINEYARD HAVEN, MASS.

Operating Institution:
WHITEFOOT TOWING & SALVAGE, INC
RFD
VINEYARD HAVEN, MASS. 02568

Name & Address of Contact:
L. B. CALDWELL, Business Manager
Tel. No. (Bus./After hrs.) (617)-693-1055

LOA 65' Beam 22' Draft 7'
Displ. Tons 41 Cruising Speed 10 KTS
Machinery DIESEL (2) H.P. 500
Type Hull/Material SUPPLY-TUG / STEEL
Accommodations:

	Crew	Scientists
Day Cruise	2	15
Overnight	2	4
Ext. Cruise	2	4

Endurance:
Days 13 Miles 1500
Usual Areas of Operation:
ENTIRE EAST COAST AREA

Lab Spaces (Describe)
432 FT^2 CLEAR DECK SPACE
65 FT^2 INTERIOR SPACE
Electric Power:
K.W. 20 Volts 110 / 240 AC/DC
Winches:
Wire Size
Length
H. P.
Booms/Cranes:
Type NATIONAL Cap 8 TONS
"A"-Frame AVAILABLE

Echo Sounder Precision Recorder
Nav. Equipment LORAN, DECCA 303, BENDIX RECORDER
Describe any special vessel capabilities

Vessel available for outside use? YES What Basis?
Cost: Per day Per week Other
Areal limits of operation ENTIRE EASTERN SEABOARD, up To 200 miles offshore
Other comments

EPA REGION I CHAIN OF CUSTODY PROCEDURES

The following are the procedures developed jointly by the Surveillance and Analysis and Enforcement Divisions of Region I, which prescribe the chain of custody procedures to be followed in the collection and analysis of water samples, during water quality and liquid waste surveys. Such procedures must be adhered to in order to ensure that data which has been collected can be introduced in evidence during the trial of a case. They are presented verbatim from a July 5, 1973 memo to the Region I EPA Administrator.

THE PROCEDURES THAT ARE DESCRIBED BELOW ARE TO BE STRICTLY ADHERED TO IN THE CONDUCT OF ALL WATER QUALITY AND LIQUID WASTE SURVEYS REQUESTED BY THE ENFORCEMENT DIVISION UNLESS WRITTEN PERMISSION TO THE CONTRARY IS OBTAINED FROM THE DIRECTOR OF THE ENFORCEMENT DIVISION:

1. Terms used herein shall have the following definitions:

    a. "chief of the sampling crew" means the senior ranking member of the sampling crew of the person designated a chief, by the Director of the Surveillance and Analysis Division.

    b. "composite sample" means a sample collected manually or by automatic sampling device in increments taken at set intervals (or continuously) over a period of time and placed in a single sample container.

    c. "Director, Enforcement Divison" means the Director of the Enforcement Division of Region I, EPA, or his designees.

    d. "Director, Survillance & Analysis Division" means the Director of the Surveillance & Analysis Division of Region I, EPA, or his designees.

    e. "EPA personnel" means persons employed by or assigned to the United States Environmental Protection Agency.

    f. "field data card" means the form attached hereto and marked "A".

    g. "field log books" means the log books used in the field by survey personnel to record data, observations, and comments regarding the collection and custody of samples.

h. "laboratory number" means the number assigned by the field data card to all samples (and parts thereof) collected at the same station, at the same depth, on the same date(s), and at the same time (or within a specified time frame in the case of a composite sample).

i. "laboratory bench books" means the books used to record the result of scientific analyses of samples.

j. "laboratory sample log books" means the log books maintained at the field laboratories and the New England Regional Laboratory to record the receipt of samples for scientific analysis, the format of which is attached hereto and marked "B".

k. "field laboratory" means any temporary or mobile laboratory operated by the Surveillance and Analysis Division of Region I, EPA.

l. "New England Regional Laboratory" [N.E.R.L.] means the New England Regional Laboratory of the United States Environmental Protection Agency.

m. "sample" means the whole or part of a substance which is collected for scientific examination or analysis.

n. "sample container" means the immediate container used to hold a sample.

o. "sample label" means the label attached to each sample that is collected, the format of which is attached hereto and marked "C".

p. "sampling crew" means those persons collecting or participating in the collection of samples at a particular station, on a particular date(s), and at a particular time (or within a specified time frame in the case of a composite sample).

q. "appropriate seal" means the material placed on a container to indicate opening of, or tampering with, the container or its contents and includes:

(1) EPA Form 7500-2 tape on cardboard boxes, paper or polyethylene bags;

(2) wire or lead seals on metal containers or wooden boxes with hinges;

(3) plastic seals on hinged and unhinged boxes.

r. "shipment sample log" means the form attached hereto and marked "D".

s. "State personnel" means persons employed by an agency or department of State government.

t. "station" means the location at which one or more samples are collected.

u. "subnumber" means the number or numbers assigned to a sample container and its contents in addition to the laboratory number.

2. Each time a station is sampled a field data card must be completely filled out by one or more members of the sampling crew.

3. All members of the sampling crew must sign their full names, as well as their initials, in the space labeled "Collector" on the field card.

4. For each sample container that is used, a sample label must be completely filled out by one or more members of the sampling crew.

5. Except in the case of a composite sample, the person actually collecting the sample must sign his full name (including middle initial) in the space labeled "Sampling Crew" on the sample label. All other members of the sampling crew must sign their initials.

6. In the case of a composite sample, the chief of the sampling crew collecting the sample must sign his full name (including middle initial) in the space labeled "Sampling Crew." All other members of the sampling crew must sign their initials.

7. Each sample label must be securely attached to the sample container immediately after collection.

8. Each member of the sampling crew must check over each sample label as soon after collection as possible to see if it is accurate.

9. Where more than one sample label contains the same laboratory number, a different subnumber must be added to each such label at the time of sample collection (e.g., 10235-1, 10235-2, etc.).

10. If the contents of a sample container are to be subdivided into several containers in the field prior to analysis, there are two permissible courses of action:

a. Sample labels for all the containers to be used may be filled out when the sample is first collected (using subnumbers), attached to the original sample container, and later attached to the containers into which the sample is divided; or

b. One sample label may be filled out for the original sample container. In this case, when the sample is subdivided, sample labels must be filled out in the same manner as the original label was filled out and attached to each container to be used. A set of subnumbers, or, if necessary, a second set of subnumbers, must be used to insure that no two labels have the same numerical identification. A circle must be drawn around the laboratory number on the original sample label in order to allow future identification of that label.

11. Whenever a photograph is taken in the field, the following information must be recorded on the back of the picture or in a field log book: the date and time of the photograph, the subject, the direction of the photograph, the photographer's signature, and the signature of a witness (if available).

12. Only members of the sampling crew that collect a particular sample should perform any of the operations related to such collection, including: placing the sample in the sample container, filling out the sample label, attaching the label to the sample container, adding the preservative to the sample, placing the top on the sample container, subdividing the sample into several containers. If anyone other than a member of the sampling crew that collects the sample performs any of such field operations, he must sign his full name (including middle initial) in the space labeled "Remarks" on the back of the sample label and note what operation he performed and the date on which he performed it.

13. During the collection of a composite sample, the automatic sampling device (if used) and the sample container must at all times be in view of a member of the sampling crew or in a location accessible only to the sampling crew.

14. Unless a sample remains in the possession of the members of the sampling crew (that is, in their sight or locked in the motor vehicle used by them), the sample container or any shipping container holding the sample container must be sealed with an appropriate seal and must remain unopened until it arrives at the laboratory where analysis of the sample is to be conducted.

15. At the time the sample container or other shipping container is sealed, the following information must be recorded in a field log book: the fact that the container was sealed; the date and time of the sealing; the laboratory number (and, if appropriate, the subnumber) of the sample; the name (or initals) of the person sealing the container; and the name (or initials) of the person recording the above information.

16. Any time a sample arrives at the laboratory where the analysis of it is to be conducted, the following information must be recorded in the laboratory sample log book: the date and time of arrival of the sample; the condition of the seal (in tact, broken, none) or acknowledgement that the sample remained in the possession of the members of the sampling crew (that is, in their sight or locked in the motor vehicle used by them) from its collection until delivery to the laboratory; the laboratory number (and, if appropriate, the subnumber) of the sample, and the names (or initials) of the persons delivering the sample, receiving the sample, and recording the above information

17. The field laboratories and the N.E.R.L. must be securely locked during non-working hours. Public access to areas where samples are stored and analyzed must be strictly limited at all times. While in the field laboratory or the N.E.R.L., all samples (including portions thereof under-going analysis) must at all times be attended by EPA personnel or stored in rooms, refrigerators, or other receptacles that are locked and accessible only to EPA personnel.

18. All persons collecting, handling, transporting, or attending samples must be continually alerr for evidence of contamination of and tampering with the samples.

19. Any indication that contamination or tampering may have occurred, must be noted on the sample label in the space labeled "Remarks," or on a sheet securely attached to the sample shipping container, together with the full name (including middle initial) of the person making the notation and the date of the notation. A description of the evidence of contamination and tampering must be noted in a field log book or laboratory sample log book and must

include the date and time of discovery, the laboratory numbers (and, if appropriate, the subnumbers) of the affected samples, the date of the notation, together with the names of the person(s) making the discovery and the notation in the log book.

20. As few people as possible should handle a sample between its collection and analysis. Except when samples are in the possession of a common carrier, all of the persons handling them must be EPA personnel or personnel of State governments who are designated in writing by the Director of the Surveillance and Analysis Division as authorized to handle samples.

21. When samples are shipped by United States Mail or by comon carrier, the immediate shipping containers must be sealed with an appropriate seal and packaged so that the seal will not be disturbed by handling during transit. (Mailed packages must be registered with return receipt requested.) A shipment sample log must be filled out by the person arranging for the shipment. His name (or initials) must appear in the space labeled "Sent by" on the shipment log. The destination of the shipment, the laboratory numbers (and, if appropriate, the subnumbers) of all samples shipped, and any identifying number found on the shipping receipts must be noted on the shipment sample log. The log must be filled out as soon as possible after shipment. All registry receipts and shipping documents must be saved.

22. Unless the contrary is indicated by the Director of the Enforcemental Division, a portion of the official sample may be furnished to a prospective defendant if he requires it and if this is feasible.

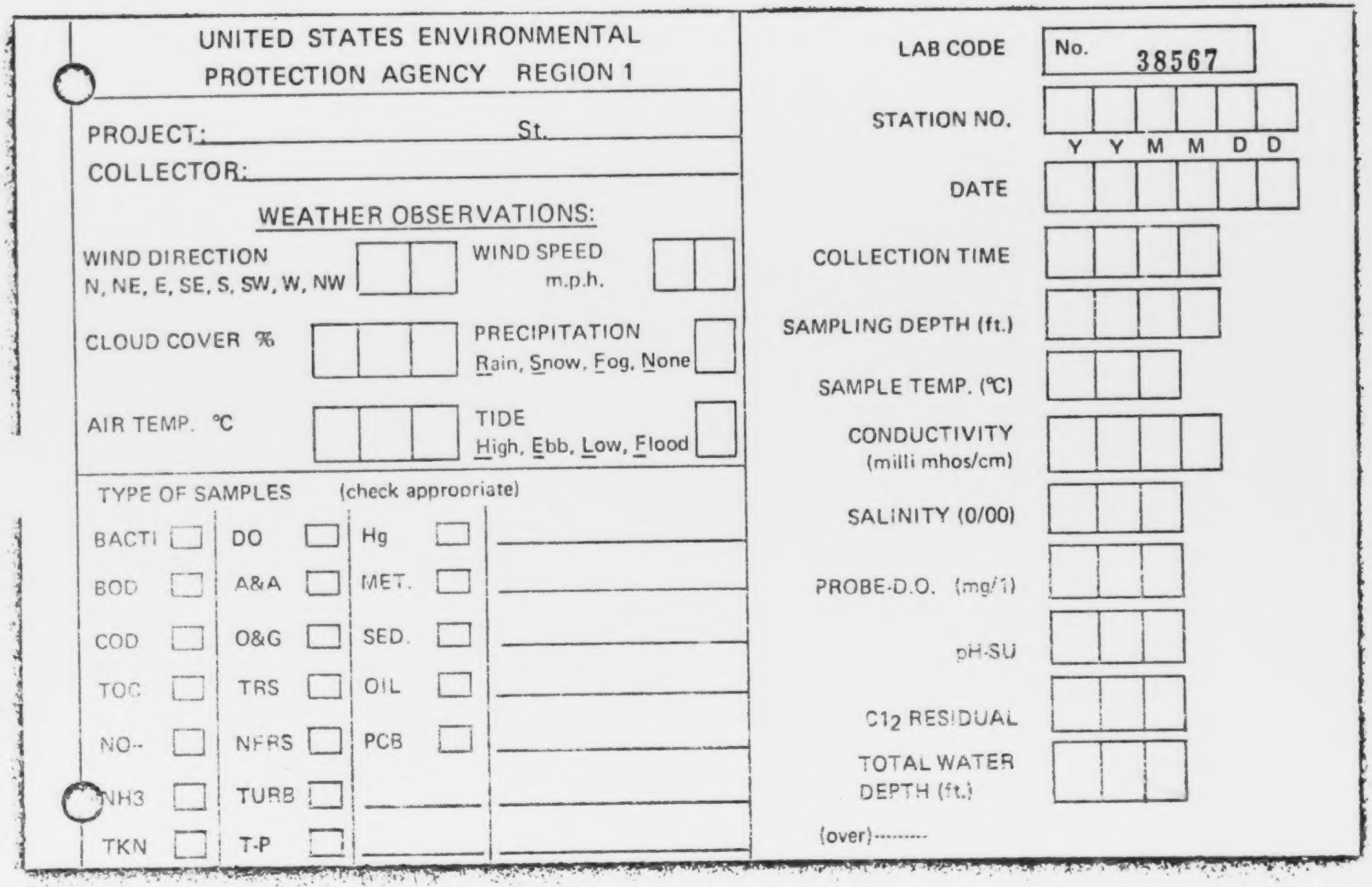
23. Used seals, used sample containers, and remnants of samples may be disposed of unless there is a written or oral request to the contrary by the Director of the Enforcement Division.

24. Field data cards, sample labels, log books, laboratory bench books, shipment sample logs, shipping documents, registry receipts, and all other records relative to the collection, custody, and analysis of samples, including any photographs that are taken, must be saved for seven years unless the Director of the Enforcement Division gives written approval to the contrary.

25. Every test result or observation recorded in log books, laboratory bench books, on field data cards, on the back of sample labels, on shipment sample logs, and in any other record that is maintained must be identified by the signature or initals (except in

the case of the back of sample labels where the full name is required) of the person or persons conducting the test or making the observation and must dated (if this information is not otherwise apparent from the face of the record). As much as possible of the field data cards and sample labels may be filled out before sampling. However, in the case of the other documents listed above, they must be filled in contemporaneously with or as soon as possible after the events they record. All records that are maintained (including any photographs that are taken) must at all times remain in the possession of EPA personnel or under lock and key and accessible only to EPA personnel.

26. The results of laboratory analysis of samples must be recorded in laboratory bench books under laboratory numbers and subnumbers.



UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY REGION 1

PROJECT: ______________ St. ______

COLLECTOR: ______________

WEATHER OBSERVATIONS:

WIND DIRECTION N, NE, E, SE, S, SW, W, NW ☐☐

WIND SPEED m.p.h. ☐☐

CLOUD COVER % ☐☐☐

PRECIPITATION Rain, Snow, Fog, None ☐

AIR TEMP. °C ☐☐☐

TIDE High, Ebb, Low, Flood ☐

TYPE OF SAMPLES (check appropriate)

BACTI	☐	DO	☐	Hg	☐	
BOD	☐	A&A	☐	MET.	☐	
COD	☐	O&G	☐	SED.	☐	
TOC	☐	TRS	☐	OIL	☐	
NO--	☐	NFRS	☐	PCB	☐	
NH3	☐	TURB	☐			
TKN	☐	T-P	☐			

LAB CODE No. 38567

STATION NO. ☐☐☐☐☐☐

Y Y M M D D

DATE ☐☐☐☐☐☐

COLLECTION TIME ☐☐☐☐

SAMPLING DEPTH (ft.) ☐☐☐☐

SAMPLE TEMP. (°C) ☐☐☐

CONDUCTIVITY (milli mhos/cm) ☐☐☐☐

SALINITY (0/00) ☐☐☐

PROBE-D.O. (mg/1) ☐☐☐

pH-SU ☐☐☐

Cl_2 RESIDUAL ☐☐☐

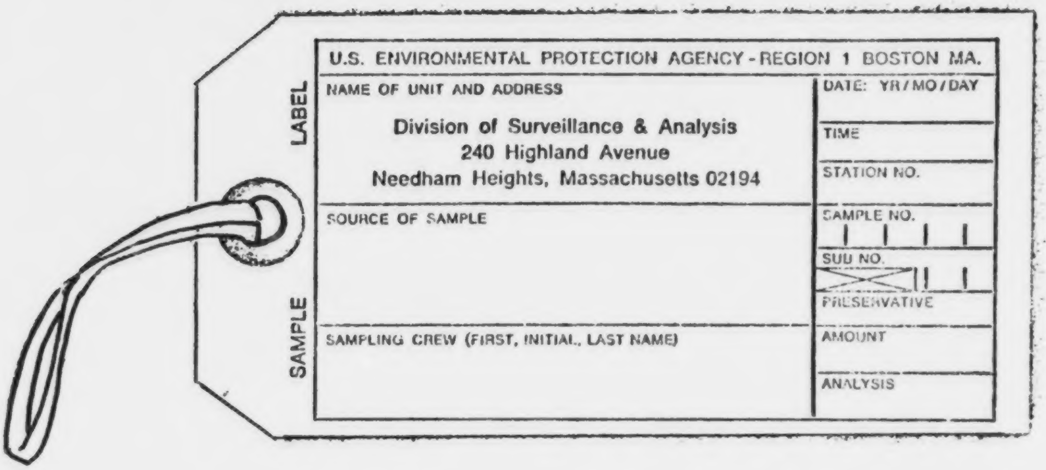
TOTAL WATER DEPTH (ft.) ☐☐☐

(over)--------

ATTACHMENT "A"

Date & Time	Laboratory numbers & subnumbers:	Delivered by (initials of person delivering sample):	Received by (initials of person receiving sample):	Condition of seal Intact (I); Broker (B); None (N):	Acknowledgement of custody (initials of chief of sampling crew):

ATTACHMENT B



SAMPLE LABEL

U.S. ENVIRONMENTAL PROTECTION AGENCY - REGION 1 BOSTON MA.

NAME OF UNIT AND ADDRESS

Division of Surveillance & Analysis
240 Highland Avenue
Needham Heights, Massachusetts 02194

SOURCE OF SAMPLE

SAMPLING CREW (FIRST, INITIAL, LAST NAME)

DATE: YR/MO/DAY

TIME

STATION NO.

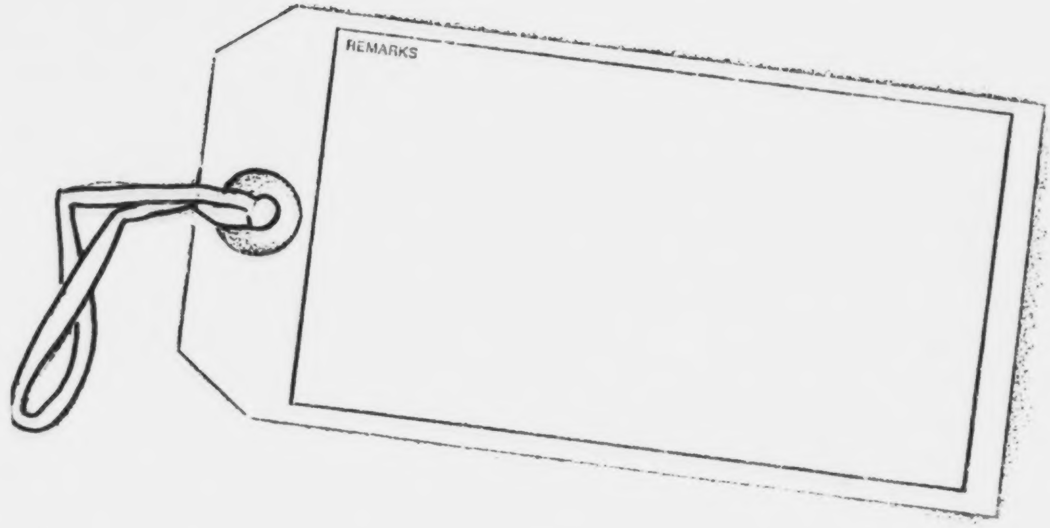
SAMPLE NO.

SUB NO.

PRESERVATIVE

AMOUNT

ANALYSIS



REMARKS

ATTACHMENT "C"

SHIPMENT SAMPLE LOG

Sample Source	Date Sent:	Laboratory Numbers & Subnumbers:
Sent by (initials):	Shipped From:	Method of Shipment: ☐ Air Freight Airline & Flight: ☐ REA ☐ Parcel Post ☐ U.S. Mail ☐ Other:
Destination:	Shipping Receipt No.:	

Description of Shipment:

No. of shipping containers: ☐ Iced ☐ Dry Ice

Shipping containers sealed by (initials):

Type of sample container:

Sample preservative:

Analyses requested:

Remarks:

Attachment D

EXECUTIVE COMMITTEE MEETINGS

Overview

An Executive Committee was established for overall guidance of Workshop and response plan activities, and to translate the results of the Workshop into recommended action items for consideration by the National Response Team. The specific objectives of the Executive Committee were to:

(1) Develop an organizational mechanism for activating the national and local components of the Regional Plan.

(2) Develop a mechanism for review, analysis, and making decisions dealing with the degree of field/laboratory studies on any specific spill impact assessment.

(3) Develop an organizational framework and mechanisms for review, critique and modification of the Regional Plan.

(4) Determine the existing resources (Federal, State, local agencies and private sector) in manpower, funds, equipment and facilities to be applied to any specific spill situation.

(5) Develop specific proposals for obtaining required funding of the Regional Plan.

(6) Provide mechanisms for assisting the On-Scene Coordinator.

The Executive Committee was comprised of responsible Federal and state officials who could potentially contribute to implementation of an ecological damage assessment response plan, and authoritatively consider matters of policy and resources. Members of the Committee are identified in Appendix D.

During the Hartford Workshop, the Executive Committee held five meetings, including two joint sessions with Panel Chairpersons.

Summary Review

An initial joint meeting of the Executive Committee and Panel Chairpersons was held on August 28th, on the eve of the Workshop. It served as a forum for reviewing the Workshop schedule and clarifying Workshop and Executive Committee objectives. Major items of discussion included: the role of various Federal agencies and the states in ecological assessment activities; plans for the development of a New England response plan; operational and scientific aspects to proposed ecological assessment; and the present need for ad hoc scientific assistance to the OSC.

The Executive Committee meeting of August 29th reviewed the day's proceedings, discussed schedule and meeting room changes, and addressed paper work and secretarial needs. Some substantive issues were discussed including the role of university support. The next Executive Committee meeting was scheduled to deal with specific Committee objectives.

The Executive Committee meeting of August 30th was divided into two groups. One, chaired by Henry Van Cleave (EPA) dealt with Executive Committee objectives (1), (2) and (3); the other, chaired by Cmdr. Joseph Valenti (USCG), addressed objectives (4), (5) and (6). Following the work of the two subgroups, the Committee met jointly to discuss and summarize Executive Committee recommendations in regard to each objective.

An Executive Committee meeting on August 31st addressed several substantive issues. These included: anticipated time frame for development of the New England regional response plan for ecological damage assessment; anticipated review of the draft response plan by the Executive Committee; establishment of a scientific advisory panel to assistant in development of the plan; the MITRE role in plan development; the funding scope of the plan; incorporation of ecological damage assessment plans in the National Contingency Plan; plans for the Alaska Workshop and the role of NOAA thereto; lead agency responsibilities for ecological damage assessment activities; future scope and objectives of the Workshop program; and the interface of scientific and operational needs.

A joint meeting of the Executive Committee and Panel Chairpersons discussed progress of the Workshop in meeting overall Workshop goals (p. vi) and the specific objectives of the Executive Committee (p. 443). Progress was summarized as follows:

- Workshop Goal 1. The proposed organization outlined in the "Report to the National Response Team on Interagency Scientific Capability to Respond to Major Oil Spills" prepared by the Task Force on Ecological Damage Assessment was accepted as the framework for the regional plan. It was recommended that the Immediate Response Coordinator* for scientific support be a member of the Regional Response Team. The proposed chain of notification of an oil spill leading to notification of the Immediate Response Coordinator for scientific support is shown in Figure 1. The Immediate Response Coordinator is responsible for all support to the Coast Guard On-Scene Coordinator (OSC) and the decisions as to the need for additional scientific support personnel required on-scene.

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*The term for the position of Immediate Response Coordinator has been changed to Scientific Coordinator/Advisor (SCA) by the NRT.

- Workshop Goal 2. The Workshop Panels prepared descriptions of projects that may be undertaken to attain this goal. These descriptions are included in the Workshop Report.

- Workshop Goal 3. The project descriptions prepared by the Workshop Panels meet this goal.

- Executive Committee Objective 1. This objective has been met as described above under Workshop Goal 1.

- Executive Committee Objective 2. These decisions will be made jointly by the Immediate Response Coordinator and the National Scientific Support Team Leader through implementation of Regional Response Plans. A National Science Review Panel is proposed to establish the objectives of the national assessment program, determine needs for longer-term research projects, and to review scientific response at specific oil spills. This committee would meet once or twice a year, and would assist in the development of Regional and National Response Plans.

- Executive Committee Objective 3. The regular review procedure for amending the National Contingency Plan will be applied to the regional plan for scientific support.

- Executive Committee Objective 4. Some of these needs have been identified by the Workshop Panels. The Immediate Response Coordinator will be responsible for knowledge of both regional and national resources available and required. This effort will be undertaken in close cooperation with local EPA and NOAA offices.

- Executive Committee Objective 5. Projects outlined by working panels will be reviewed to determine those that can be funded by existing programs. In addition, for planning purposes a more comprehensive regional assessment program will be identified based on an assumed $1 million budget above existing resources.

- Executive Committee Objective 6. The Immediate Response Coordinator is responsible for providing assistance to the On-Scene Coordinator.

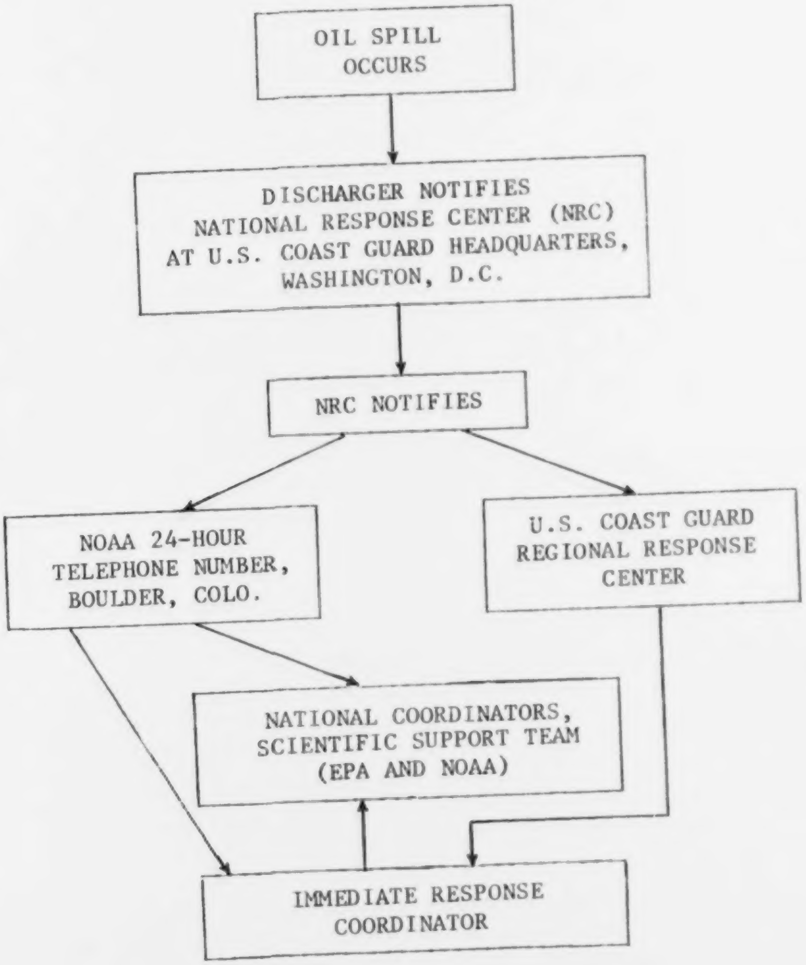
OIL SPILL OCCURS
DISCHARGER NOTIFIES NATIONAL RESPONSE CENTER (NRC) AT U.S. COAST GUARD HEADQUARTERS, WASHINGTON, D.C.
NRC NOTIFIES
NOAA 24-HOUR TELEPHONE NUMBER, BOULDER, COLO.
U.S. COAST GUARD REGIONAL RESPONSE CENTER
NATIONAL COORDINATORS, SCIENTIFIC SUPPORT TEAM (EPA AND NOAA)
IMMEDIATE RESPONSE COORDINATOR

FIGURE 1

PROCEDURE FOR NOTIFYING THE IMMEDIATE RESPONSE COORDINATOR FOR SCIENTIFIC SUPPORT IN THE EVENT OF A MAJOR OIL SPILL

It was also recommended that the Workshop Chairperson prepare a letter report to the National Response Team on results of the Workshop.

Recommendations to the NRT

The Workshop Coordinator reviewed results of the Region I Workshop with the National Response Team on September 8, 1977. Based on Executive Committee discussions he recommended the following action items for consideration by the NRT:

- Modification of the National Contingency Plan to incorporate an ecological damage assessment program as specified in the report to the NRT by the Task Force on Ecological Damage Assessment (dated June 1977) and the recommendations of the Executive Committee at the Hartford Workshop.
- Resolution of lead agency jurisdiction between EPA and NOAA for ecological damage assessment activities. It is recommended that EPA assume lead responsibility for all spills originating within the baseline from which the territorial sea is measured ("near-shore" spills) and that NOAA assume lead responsibility for spils originating beyond this line ("off-shore" spills).
- Formalize the development and implementation of ecological assessment activities in consideration of the Draft National Plan and the recommendations of the Hartford Workshop. Specifically, it is important that each primary agency appoint a full-time respresentative to continue development and implementation of the ecological damage assessment effort.
- Approval of the entire series of Regional Workshops and the development of regional and national plans for ecological damage assessment.
- Notification of all EPA Regions and USCG Districts of the Draft National Plan and the Workshop program.
- Establishment of a National Scientific Advisory Panel to assist in the development and scientific oversight of Ecological Damage Assessment Response Plans.
- Survey of resources of agencies represented on the NRT to support implementation of Ecological Damage Assessment Response Plans.

- Designation of a lead agency to seek additional funding support for implementing the response plans.

- Seeking allocation of a portion of the proposed $200M "superfund" to support the ecological damage assessment effort.

- Investigation of other potential funding sources for the ecological damage assessment program, including the National Science Foundation, American Petroleum Institute, and the Smithsonian Institution.

NRT Response to Workshop Recommendations

Overall, the recommendations developed at the Hartford Workshop were well received by the NRT. A letter from the Chairman of the NRT to the Workshop Coordinator describes the NRT position on each recommendation, and is presented in Appendix G.

APPENDIX A

WORKSHOP SCHEDULE

WORKSHOP SCHEDULE

Sunday, August 28, 1977

8:00 - 11:00 p.m.	Joint Meeting of Panel Chairpersons and Executive Committee

Monday, August 29, 1977

9:00 a.m. - 12:00 p.m.	Plenary Session
9:00 - 9:10 a.m.	Introductions and Welcome Paul Lefcourt, Workshop Chairman
9:10 - 9:20	Welcoming Address Bill Adams, EPA Region I Administrator
9:20 - 9:40	Description of Federal Involvement in Oil Spills Henry VanCleave, EPA, Washington, D.C.
9:40 - 10:00	Background on the National Response Team (NRT) Capt. John Kirkland, USCG, Washington, D.C.

****

BREAK

****

10:20 - 10:40	Description of NOAA/USCG SORT David Kennedy, NOAA-ERL, Boulder, CO
10:40 - 11:00	Socioeconomic and Legal Considerations Jan Praeger, EPA-ERL, Narragansett, RI
11:00 - 11:20	Plan for Workshop - Paul Lefcourt • Charge to panels • Organization • Planned results of Workshop • Future activities
11:20 - noon	Open Discussion - Chaired by Paul Lefcourt • Comments on speakers • Questions • Recommendations: on Workshop performance

12:00 - 1:00 p.m.	******************** LUNCH ********************
1:00 - 5:00	Panels Meet in Respective Break-out Rooms
5:00	Panels Terminate for Day
5:00 - 7:00	Panel Chairpersons Write Reports
6:00 - 8:00	Reception - Cash Bar
7:00	Chairpersons Submit Handwritten Copy to Typists
9:00 - 11:00	Executive Committee Meets to Review Panel Reports and Discuss Following Day's Activity

Tuesday, August 30, 1977

9:00 a.m. - 12:00 p.m.	Plenary Session Each Panel Chairperson Reports to General Session

9:00 - 9:15 a.m.	Water Column Biology
9:15 - 9:30	Benthic Biology
9:30 - 9:45	Microbiology/Biodegradation
9:45 - 10:00	Histopathology
10:00 - 10:15	Birds/Marine Mammals
10:15 - 10:30	Laboratory Toxicity Studies
10:30 - 10:45	Chemical Analyses/Fate Studies
10:45 - 11:00	Physical Processes
11:00 - 11:15	Socioeconomic/Legal Considerations
11:15 - 11:30	Facilities
11:30 - noon	Open Discussion

	********************
12:00 - 1:00 p.m.	LUNCH
	********************
1:00 - 5:00	Panels Meet
7:00	Deadline for Panel Chairperson to Submit Copy to Typists
1:00 - 5:00	Executive Committee Meeting

Wednesday, August 31, 1977

9:00 a.m. - 10:00 a.m.	Panel Chairpersons Meet
10:00 - 12:00	Panels Meet
	********************
12:00 - 1:00	LUNCH
	********************
1:00 - 4:00	Panels Meet
2:00 - 4:00	Executive Committee Meeting
4:00 - 6:00	Joint Meeting of Executive Committee and Panel Chairpersons
8:00	Chairpersons Submit Handwritten Copy to Typists

APPENDIX B

PROJECT REPORT FORMAT

Panel ____________________

Project #____________________

Priority Rank ______________

PANEL GUIDANCE FORMAT

1. Proposed Title of Project

2. Description of Project
   - Be brief! Outline the objectives of the study, how it is carried out, and anticipated results.
   - Give references if possible.

3. Performing Organization
   - Indicate the organization(s) the panel is certain has the capability to perform the study. Give names if possible.
   - Suggest possible performing organizations.

4. Habitats Applicable
   - Identify one or more from listing of New England habitats.

5. Conditions Applicable
   - Consider all possible conditions required for successful completion of study. For example, in a study of impact on benthic fauna some conditions are:
     - oil is incorporated in sediment
     - benthos at control site(s) is uncontaminated

   - Consider what weather/climate, geographical, ecological, economic or other condition(s) are necessary before putting this study into effect.

6. Oil Type Applicable
   - Specify what oils or groups of oils (e.g., crude, no. 6, no. 4, no. 2, gasoline, etc.) project applies.

7. Time Frame
   - Identify the total inclusive period of the study and the actual required work periods, e.g.:

     > "The study requires a minimum five-year period consisting of four one-week sampling periods at one field sampling per season. Sample work-up and data analysis requires an additional 8 weeks/year for a spill of ________ size."

8. Cost
   - Estimate the intensive cost of the project, i.e., give a sliding cost based on the size of spill and area of impact, e.g.:

Area (Km^2)	Cost $
10	100,000
50	800,000
100	1,500,000

- Show how you arrived at your figures.

9. Equipment Needs/Equipment Available
   - Be specific! What kind and how much?
   - Available equipment means it can be used for the project with little advance notice.
   - Equipment means sampling gear, sample containers, field and laboratory instrumentation, glassware, communication equipment and various kinds of hardware.

10. Facility Needs/Facilities Available
    - Be specific by habitat and kind and size of spill.
    - Facilities means analytical laboratories, ships, boats, aircraft, land vehicles, living accommodations for lodging, staging and action center, etc.

11. Personnel Needs/Personnel Available
    - Identify if proper personnel are currently available. What response time is needed? Could they respond within the stated time frame?
    - Give names, addresses, tel. no. if possible.
    - If personnel are not available give indication of what disciplines, number are necessary. Suggest possible workers!

12. Support Services (Concurrent or Associated Studies)
    - Indicate the kinds of projects that must be performed to provide data essential for the proper functioning of this project.
    - For example, if project dealt with determining alterations in benthic community diversity a study mapping the distribution of oil in sediments would likely be desirable.
    - Another example might be the need for histological examination of selected organisms.

13. Payoff
    - Describe in adequate detail what the results of such a study would be in contributing to determining the overall ecological impact.
    - Consider the possible results from the perspective of: (1) scientific interest, i.e., how much of a unique contribution does the study make to our understanding of oil pollution impact on marine ecosystems and (2) how does the study lend itself to determining the economic ($) costs of damage to "natural resources"?

14. Limitations
    - This is a very broad category. Considerations of feasibility, utility and operational problems come to bear. Environmental factors, weather, location, ongoing clean-up operations, nature of oil, habitat type, season, etc. all play a role in determining the limitations.
    - Ask if the project answers all questions dealing with assessing ecological impact under all possible scenaries and conditions. Of course not! O.K., then what are the major flaw?

New England Habitats

1. Pelagic system - including inland, coastal, offshore areas, and migratory species
2. Offshore bottom
3. Rocky shore
4. Sand shore
5. Salt marsh
6. Oyster - mussel reef
7. Worm - clam flat
8. Shallow salt pond

APPENDIX C

PANEL CHAIRPERSONS

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APPENDIX D

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APPENDIX F

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APPENDIX G

RESPONSE OF THE NRT TO HARTFORD WORKSHOP RECOMMENDATIONS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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4 NOV 1977

OFFICE OF WATER AND
HAZARDOUS MATERIALS

Dr. Paul Lefcourt
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Dear Paul:

On behalf of the National Response Team (NRT) I would like to commend you on your effort in developing a national plan of action for assessing the ecological damage caused by oil spills.

Since the 8 September meeting, the NRT has conducted an indepth review of your report on the Hartford Workshop. As a result, it is agreed that the report identifies critical issues that require resolution in order for the Task Force on Ecological Damage Assessment to carry out its charge. The NRT also feels that it is essential that replies to the ten action items contained in your report be provided in sufficient time to assist in the planning of future workshops. Accordingly, the following comments are provided for your guidance:

Proposal: Establishment of a National Scientific Advisory Panel to assist in the development and scientific oversight of Ecological Damage Assessment Response Plans.

Response: The NRT concurs in the need for a mechanism to assess the need to perform new research and development in support of the damage assessment program. We are asking the Research and Development Committee of the NRT to set up a mechanism for accomplishing this.

Proposal: Survey of represented agency resources to support implementation of Ecological Damage Assessment Response Plans.

Response: The NRT concurs that the survey of available resources should be conducted. A National Inventory of Response Equipment is being planned to provide information on the various major resources of the Federal agencies. When completed, the inventory will be distributed to all Regional Response Teams.

Proposal: Designation of a lead agency to seek additional funding support for implementing the response plans.

Response: The NRT concurs with the proposal to designate a lead agency to seek funding support for conducting ecological damage assistance. However, further action on this item must be deferred pending the outcome of the "superfund" legislation at which time this matter will be reviewed.

Proposal: Seeking allocation of a portion of the proposed $200M "superfund" to support the ecological damage assessment effort.

Response: The NRT will forward a letter to the Council on Environmental Quality urging the Council to advise the Administration that the currently proposed "superfund" legislation be amended so as to permit up to $4M of the fund to be expended annually in support of damage assessment activities as deemed necessary by the administrator of the fund.

Proposal: Investigation of other potential funding sources for the ecological damage assessment program, including the National Science Foundation, American Petroleum Institute, and the Smithsonian Institute.

Response: The NRT agrees that the concept of obtaining funds from other than government sources for the damage assessment program is feasible provided that the criteria established for this method of funding are complied with. Further action on this item must await the establishment of budget levels and the receipt of contributions by government agencies to determine what additional funds are required to implement the ecological damage assessment plan.

Proposal: Modification of the National Contingency Plan to incorporate an ecological damage assessment program as specified in the report to the NRT by the Task Force on Ecological Damage Assessment (dated June 1977) and the recommendations of the Executive Committee at the Hartford Workshop.

Response: It was agreed that the NRT at its August 12, 1977 meeting that a comprehensive review and evaluation would be made on the results of the workshops. Following this action, the NRT will then take appropriate action to incorporate the approval ecological damage assessment program into the National Contingency Plan.

Proposal: Resolution of lead agency jurisdiction between EPA and NOAA for ecological damage assessment activities. I have suggested that EPA assume lead responsibility for all spills originating within the baseline from which the territorial sea is measured ("near-shore" spills) and the NOAA assume lead responsibility for spills originating beyond this line ("off-shore" spills).

Response: The NRT agrees with the concept that EPA assumes lead responsibility for accomplishing ecological damage assessment for all spills originating inland from the baseline from which the territorial sea is measured and that NOAA assumes lead responsibility for accomplishing assessment for spills occurring seaward of this line.

Proposal: Formalize the development and implementation of ecological assessment activities in consideration of the Draft National Plan and the recommendations of the Hartford Workshop. Specifically, it is important that each primary agency appoint a full-time representative to continue development and implementation of the ecological damage assessment effort.

Response: The NRT feels that staffing is important to the success of the program and will urge each participating agency on the NRT to give this matter its full attention.

Proposal: Approval of the entire series of eight remaining Regional Workshops and the development of regional and national plans for ecological damage assessment.

Response: The NRT feels that five workshops are sufficient to generate the information needed to modify the National Contingency Plan. The NRT believes that a representative crossection of research needs can best be obtained by holding workshops on the east, gulf and west coasts, in the area of Alaska and in the Great Lakes region. The NRT recognizes the need for additional regional workshops to meet unique requirements. These workshops should be conducted by the appropriate RRTs as required without the approval of the NRT.

Proposal: Notification of all EPA Regions and USCG Districts of the draft National Plan and the Workshop program.

Response: The NRT concurs that information on the workshop program should be disseminated to all EPA regions and USCG districts. The NRT recommends that the Regional Response Teams be invited to participate.

In addition to the foregoing, the NRT wishes to provide you the following additional guidance.

o The NRT deems it advisable to establish a regional response structure to accomplish the required damage assessment. The responsibility for establishing and maintaining this regional structure will be borne by individuals from the Environmental Protection Agency and the National Oceanic and Atmospheric Agency as designated in Attachment 1. The designated individuals will function as Scientific Coordinators/Advisor (SCAs) to the Regional Response Teams of the region to which they have been assigned. The anticipated duties of the SCAs are outlined in Attachment 2.

o The NRT deems it advisable that a National Scientific Coordination Team be established for the purpose of coordinating an assessment effort which is determined to be beyond the ability of an affected region. The Team will be chaired by Dr. Paul Lefcourt of EPA for "near-shore" spills and by Robert E. Beck of NOAA, Dr. Ledolph Baer, alternate for "offshore" spills. Each Regional Scientific Coordinator/Advisor will also serve as a member of the Team. The National Scientific Coordination Team will serve the National Response Team in an advisory capacity.

Copies of this letter are being forwarded to Mr. John Robinson, NOAA, who will chair the Alaska workshop and to each RRT.

The NRT requests that the three remaining workshops be completed as soon as possible. It would also be most helpful if you could coordinate with the workshop contractor to ensure that each planned workshop is provided with the latest list of desired R&D projects and any other pertinent information such as format for collecting scientific support information in sufficient time to allow the results of the previous workshops can be applied in future ones.

Sincerely yours.

Kenneth E. Biglane
Chairman, National Response Team

Enclosures

Concur:

Captain John R. Kirkland
United States Coast Guard
Vice Chairman, National Response Team

Note: Attachment 1 is the list of regional scientific coordinators to be developed by EPA and NOAA

Attachment 2

Anticipated duties of Region Scientific Coordinators/Advisors

The duties of the Regional Scientific Support Coordinators/Advisors are to:

a. Perform liaison with the scientific community within the region to determine the availability and ability of the community to perform anticipated damage assessment requirements which may be necessitated by an oil spill.

b. Establish, in cooperation with the scientific community within the region, the various interests for accomplishing ongoing research in conjunction with a spill of opportunity.

c. Establish in, cooperation with the scientific community within the region, the kinds of research that are considered necessary to improve the existing capability to perform work in support of damage assessment activities.

d. Arrange for resources and coordinate as necessary On-Scene Coordinator requests for the performance of damage assessment activities received by the RRT.

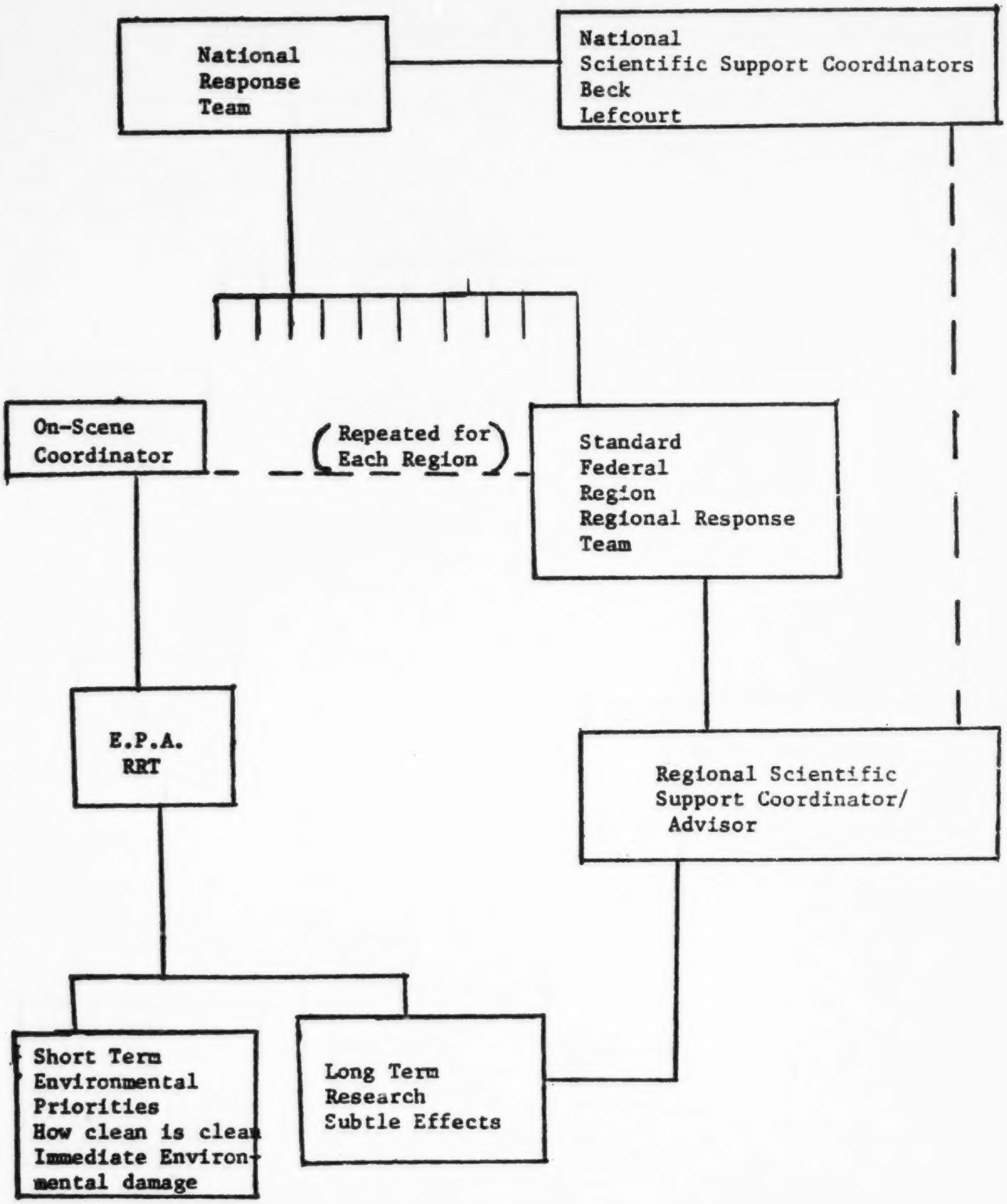
e. Evaluate the potential for accomplishing research and development projects at a spill of opportunity. Arrange for and coordinate as necessary such efforts as are deemed appropriate.

f. Coordinate all other scientific efforts being performed in the area of the spill by Federal and State agencies in conjunction with other programs or authorities.

g. Serve as the regional representative to the National Scientific Support Team.

Attachment 3

Organizational Relationship Between NRT, RRT and Scientific Support Coordinators


National Response Team
National Scientific Support Coordinators Beck Lefcourt
On-Scene Coordinator
Repeated for Each Region
Standard Federal Region Regional Response Team
E.P.A. RRT
Regional Scientific Support Coordinator/ Advisor
Short Term Environmental Priorities How clean is clea Immediate Environmental damage
Long Term Research Subtle Effects